

# **373 Series Coating Thickness Testers**

## **LE-373/LH-373/LZ-373**



### **Operating Manual**

## Coating Thickness Tester Safety Precautions

---

- Be sure to carefully follow all safety precautions.

Carefully read operating manual.

- Do not use the unit if it is not functioning properly.

Immediately contact our service representative if the unit malfunctions or does not operate properly.

- Measuring of Warning Indications.

The symbols indicated below are used in the operating manual and on the unit itself in order to prevent accidents due to misuse of the product. These symbols have the following meanings:



### **Caution**

This symbol indicates information important for the understand in order to safety operate the product.

# Contents

1. Measuring Principles and Characteristics.....	4
2. Instrument view .....	6
3. Display and Keypad Functions .....	8
4. Specifications .....	9
5. Preparations for Operation .....	10
6. Operation Method.....	11
7. Settings .....	12
8. Calibration .....	24
9. Battery Replacement.....	31
10. Data output format.....	32
11. Troubleshooting .....	33
12. Notes for Measuring and Handling .....	34

# 1. Measuring Principles and Characteristics

- The model LE-373 electromagnetic coating thickness tester is designed to measure the thickness of non-magnetic coatings such as paint or plating on magnetic metal substrates (iron or steel).
- The model LH-373 Eddy Current coating thickness tester is designed to measure the thickness of insulating coatings such as alumite or paint on non-magnetic metal substrates (such as aluminum or copper, etc.).
- The model LZ-373 dual-type coating thickness tester is designed to measure the thickness of either non-magnetic or insulating coatings on either magnetic or non-magnetic metal substrates.

## <Applicable Coatings>

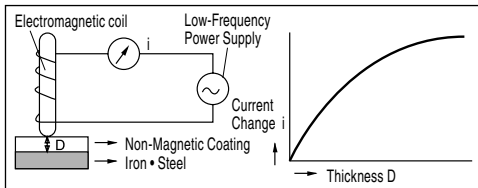
Model	LZ-373			
Applicable Coatings	LE-373		LH-373	
	Paint	Plastic	Paint	Alumite
	Lacquer	Resin	Rubber	Plastic
	Rubber	Enamel	Enamel	Lacquer
	Lining	Zinc	Resin	Other
	Chrome	Tin		
	Copper	Aluminum		
	Other			
Substrate	Iron Steel		Aluminum, Copper, Brass, etc.	

- A Beryllium-copper calibration foil is required in order to measure the thickness of plating coatings.

### •LE-373

**(Electromagnetic measurement method : For measuring the thickness of non-magnetic coatings on magnetic metal substrates)**

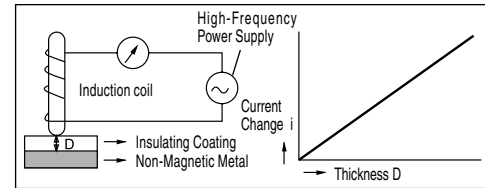
When an alternating current electromagnet is brought near iron (or other magnetic metal) the number of magnetic flux lines passing through the coil changes in proportion to the distance, thereby causing a change in the voltage at the ends of the coil. This change in voltage is determined from the current value and this is used to compute the thickness of the coating.



### •LH-373

**(Eddy Current measurement method: For measuring the thickness of insulating coatings on non-magnetic metal substrates)**

An eddy current is produced in the surface of a metal when a coil through which a current of fixed frequency is brought near the metal. This eddy current and the voltage at the ends of the coil change in proportion to the distance between the coil and the metal surface. This change can be determined from the current value and this is used to calculate the thickness of the coating.

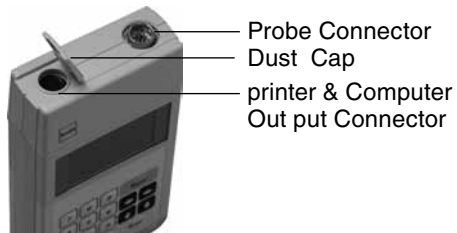


### •LZ-373(Dual Electromagnetic and Eddy Current Type)

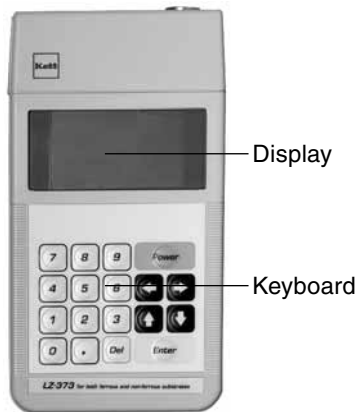
The model LZ-373 is a dual type coating thickness tester which features both the electromagnetic and Eddy Current measurement methods.

## 2. Instrument view

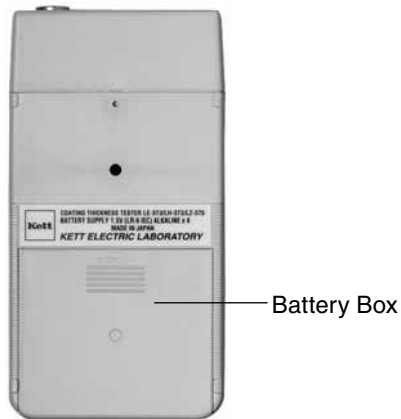
### Main part



**Top View**

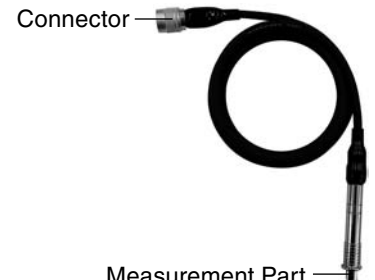


**Front Panel**

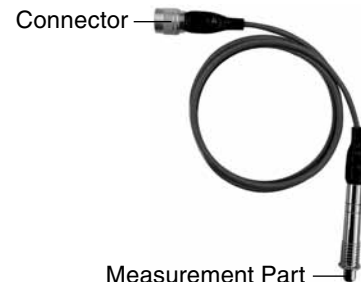


**Rear Panel**

### Probe

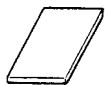


**Fe Probe (Black Cable)  
Electromagnetic "LEP-J"**

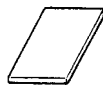


**NFe Probe (Gray Cable)  
Eddy Current "LHP-J"**

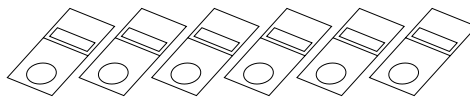
## Accessories



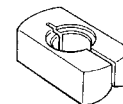
Iron Substrate (FE-373)  
(For LE-373,LZ-373)



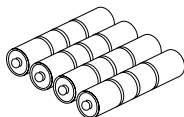
Aluminum Substrate (NFE-373)  
(For LH-373,LZ-373)



Standard Calibration Foils  
(LE-373,LZ-373 : 6pcs / LH-373 : 5pcs)



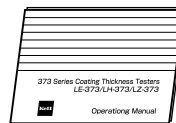
Probe Adaptor



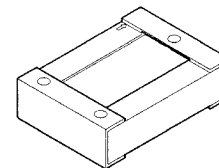
Batteries size AA (4pcs)



Carrying Case



Operating Manual

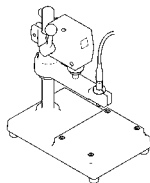


Calibration Foilcase

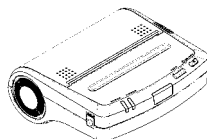
## Optional Accessories



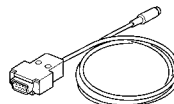
Calibration Foils  
(thicknesses other than  
those supplied)



Measuring Stand  
LW-990



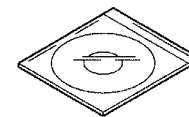
Printer VZ-380  
(with printer  
cable VZC-60)



Personal  
computer cable  
VZC-53



RS-232C-USB  
converter



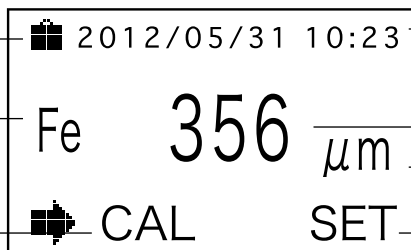
Data Logger  
Software  
"LDL-03"

### 3. Display and Keypad Functions

Battery alarm (see p. 31)

Measuring method  
(FE : Electromagnetic or  
NFe : Eddy-Current)

Calibration (see p. 24)





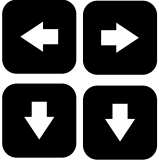
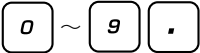

Date & Time or Lot & Data numbers  
(see p. 19)

Measurement Value

Measurement Units (see p. 21)

Settings (see p. 12)

**\*Refer to the page indicated in parentheses for the functions or purpose of each pattern.**

Operation Keys	Functions	Operation Keys	Functions
Power Key 	Turns the power on and off.	Enter Key 	Confirms the item or value displayed on the screen.
Scrolling Key 	Used to move to the desired item on the screen.	Numeric Key 	Used to enter numeric values.
		Delete Key 	Used to delete an entered numeric value.



## 4. Specifications

Model / Measuring Method	LZ-373 / Electromagnetic and Eddy-current	
	LE-373 / Electromagnetic	LH-373 / Eddy-current
Probe Type	LEP-J (Fe)	LHP-J (NFe)
Applications	Non-magnetic coatings on magnetic metal (iron, steel)	Insulating coatings on non-magnetic metal (non-iron)
Measurable Range	0 to 2500µm or 99.0 mils	0 to 1200µm or 47.0 mils
Measuring Accuracy	Under 50µm: ±1µm, 50µm to under 1000µm: ±2%, 1000µm and over: ±3%	
Resolution	Under 100µm: 0.1µm, 100µm and over: 1µm	
Data Memory	Approx. 39,000 points	
Application Memory	100 (LZ-373:50 types each of electromagnetic and eddy-current)	
Display Method	Digital (LCD with backlight, smallest display unit: 0.1µm)	
External Output	PC (USB or RS-232C), printer (RS-232C)	
Power Supply	1.5 V alkaline batteries (size AA) x 4	
Power Consumption	80 mW (with backlight off)	
Battery Life	100 hours (continuous use with backlight off)	
Operating ambient temp.	0 to 40 °C	
Functions	16, various settings	
Dimensions & Weight	Main unit: 75 (W) x 145 (D) x 31 (H) mm, 0.34 kg	
Accessories	Iron substrate (FE-373), aluminum substrate (NFE-373), calibration foil set, probe adapter, carrying case, 1.5 V batteries (size AA alkaline) x 4, operating manual	
Options	Calibration foils (other than the furnished set), measuring stand LW-990, printer VZ-380 (with printer cable VZC-60), Personal computer cable VZC-53, RS-232C-USB converter, data management software "Data logger software LDL-03"	

## 5. Preparations for Operation

### (1) Insert the batteries

The battery cover is opened by sliding the battery cover on the rear of the case in the direction indicated by the arrowhead mark ( " Δ " ).

Insert 4 size AA alkaline batteries into the battery compartment as indicated by the picture in the compartment. Take care to align the positive and negative ends of the batteries correctly.

### (2) Selecting and Connecting the probe (LZ-373)

Select a probe appropriate to the type of sample to be measured with switching the main unit off.

#### (LE-373 • LZ-373)

Non-magnetic coating on magnetic metal substrates:

Electromagnetic type probe ➡ **Fe probe (Black)**<LEP-J>

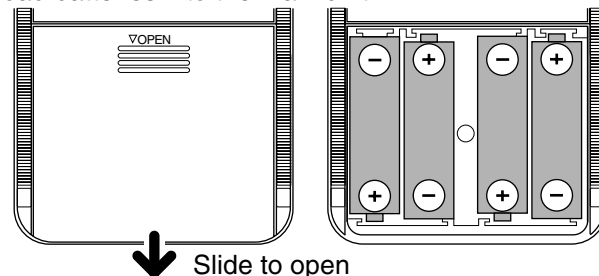
#### (LH-373 • LZ-373)

Insulating coatings on non-magnetic metal substrates:

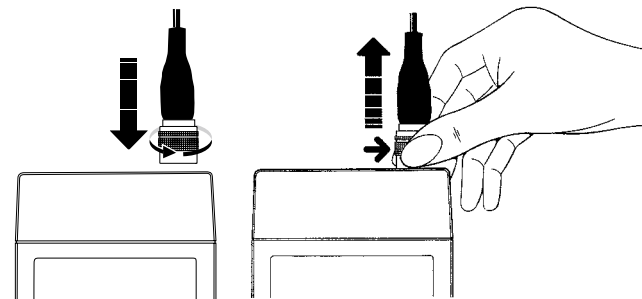
Eddy current type probe ➡ **NFe probe (Gray)**<LHP-J>

- The probe can be easily connected to the main unit by turning a little while softly pressing it into the probe socket on clockwise of the main unit.
- When removing the probe from the main unit, always be sure to grip, the metal fitting at the end of the probe cord connected to the main unit. Note that the probe can not be disconnected by pulling on the black portion of the cord.

Load batteries into the main unit



Connecting the probe



## 6. Operation Method

### (1) Probe selection and attachment

Check that the power supply is off and then attach either the LEP-J or LHP-J probe according to the substrate to be measured (see p. 10).

### (2) Power ON

Press the Power key.

### (3) Calibration

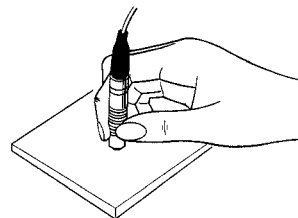
Check whether the measurement target has already been calibrated. **If not, then perform calibration and register the calibration curve (application) (see p.24).**

### (4) Measurement

The probes are of the "one-point contact constant-pressure type," whereby a constant load is applied to the tip of the probe. As shown in the figure on the right, hold the part near the measuring part and lower the probe rapidly so that the probe is at a right angle in relation to the measurement surface. To prepare for the next measurement, lift off the probe tip once at least 10 mm from the measurement surface.

**When measuring a cylindrical object or continuously measuring a flat surface, the use of a probe adapter allows stable measurement.**

#### Probe usage method



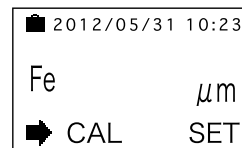
Rapidly lower the probe onto the measurement surface.

#### Probe adapter usage method

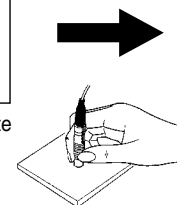


Attach the probe adapter to the tip of the probe and secure it by tightening the screw.

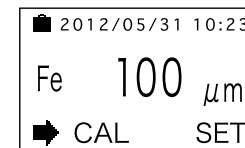
#### Display Example (Electromagnetic Measurement Mode)



Measurement enabled state



Measurement



Measurement result

## 7. Setting

- The following 16 functions can be selected on **SET** mode.




①	Application	(P.14)
②	Substrate Cal.	(P.14)
③	Delete Data	(P.15)
④	Data Memory	(P.16)
⑤	Limits	(P.17)
⑥	Statistics	(P.18)
⑦	Disp.Property	(P.19)
⑧	Date/Time	(P.19)
⑨	Auto Off Time	(P.20)

⑩	Brightness	(P.20)
⑪	Lighting Time	(P.21)
⑫	Unit	(P.21)
⑬	Data Output	(P.22)
⑭	Lot Splitting	(P.22)
⑮	Hold / Continues	(P.23)
⑯	Maintenance	(P.23)
⑰	Esc	

\* Refer to the page indicated in parentheses for the functions or purpose of each pattern.

## ● Procedure of Various Functions

(1) To set various function, select **SET** by pressing  key.

Press  key and the various functions will be displayed.

(2) Select a function you required by  or  keys, and press  key.

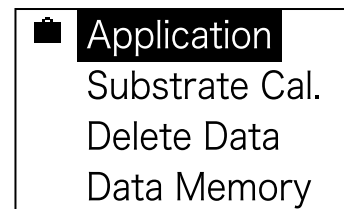
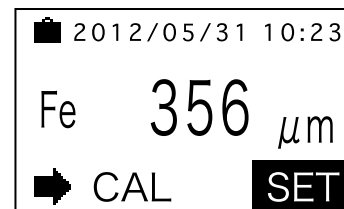
In case of right diagram, **Application** function is selected.

\* Only 4 functions are displayed in the manner shown on the right, but the other functions will be also displayable in the ①-⑰ order indicated p.12 by scrolling.

\* There are 16 various functions that can be set. (⑰ Esc is excluded)

\* Once a function is set, it will remain in memory until changed even if the power is switched off.

### <Display Example>



## ① Application

**LE-373 & LH-373 :** A total of 100 applications (calibration curves) can be set.

**LZ-373 :** A total of 100 applications , consisting of application numbers 0 to 49 for the electromagnetic type measurement and application numbers 50 to 99 for the eddy-current type measurement, can be set.

(1) Perform steps (1) and (2) on p.13.

(2) Press the Del key, and after the displayed application number bar has been deleted, enter the desired application number. Then press the Enter key to apply your selection and return to the measurement screen.

\* Once an application number has been set, it is saved even after the power is switched off until the next time it is changed.

\* LZ-373 : The selectable application number range is 0 to 49 for Fe and 50 to 99 for NFe. If an out-of-range number is selected, an error is displayed.

(3) To leave the application number unchanged, select **Esc** with the → key, and then press the Enter key. The screen will change back to the measurement screen without changing the application number.

Application
Fe    25
Esc

Application
Err   55
Esc

Application
Fe    25
Esc

## ② Substrate Cal.

Once substrate calibration has been done, it is not necessary to perform calibration for subsequent measurements. However, if the object to be measured is changed or the probe is replaced, etc., calibration must be performed again.

\* A substrate refers to a piece made with the same material and shape as the pieces to be measured, but not covered with coating (plating or paint).

(1) Perform steps (1) and (2) on p.13.

Air	N=0
Mea	
AV.	
Esc	Fe00

(2) Point the probe in the air and press the Enter key. Measurement is performed automatically 7 times.

Air	N=1
Mea	27512
AV.	27512
Esc	Fe00

⋮

Air	N=7
Mea	27513
AV.	27512
Esc	<b>ENT</b> Fe00

(3) Press the Enter key.

■ Substrate N=0	
Mea	
AV.	
Esc	Fe00

(4) The provided substrate is measured 7 times.

■ Substrate N=1	
Mea	36495
AV.	36495
Esc	Fe00

⋮

■ Substrate N=7	
Mea	36505
AV.	36501
Esc	<b>ENT</b> Fe00

(5) Press the Enter key to execute calibration and then return to the measurement screen.

### ③ Delete Data

The measurement data in Data Memory can be deleted.

(1) Perform steps (1) and (2) on p.13.

(2) Press the Del key, and after the displayed data number has disappeared, enter the data number to be deleted from the numeric keypad.

■ Delete Data	
N=0258	
	45.8 $\mu$ m
Esc	All

Then press the Enter key to execute the deletion and then return to the measurement screen.

(3) To delete all the data in the memory, press the → key to select **All**.

Press the Enter key to delete all the data and then return to the measurement screen.

(4) To not delete data, select **Esc** by pressing the ← or → key. Then press the Enter key to return to the measurement screen without deleting anything.

## ④ Data Memory

Set whether or not to save the measurement data to the data memory.

(1) Perform steps (1) and (2) on p.13.

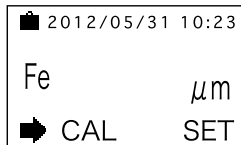
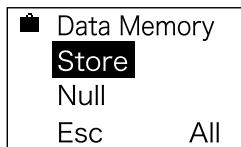
(2) To save the measurement data, select **Store** by pressing the  $\uparrow$  or  $\downarrow$  key.

Then press the Enter key to set the data to memory and then return to the measurement screen.

**\*After this setting is done, the measurement data is saved in the internal memory.**

**\*To execute Statistics (see p. 18), prior to executing measurement, set Store. If this setting is done after measurement, or if Null is set, the measurement data is not saved to internal memory until Statistics is executed.**

(3) Press the Del key to delete the recent measurement data.



(4) To cancel saving to data memory, select **Null** by pressing the  $\uparrow$  or  $\downarrow$  key.

Then press the Enter key to cancel the setting and return to the measurement screen.

(5) To leave the setting unchanged, select **Esc** by pressing the  $\downarrow$  key, and then press the Enter key to return to the measurement screen without changing the setting.

(6) If the remaining memory capacity becomes insufficient, the screen on the right is displayed. To delete all the data in the memory, select **All Clear**.

〈Memory Over〉  
**All Clear**  
Skip

Then press the Enter key to execute deletion and return to the measurement screen.

To execute Data Output, etc., select **Skip**. Press the Enter key to return to the measurement screen without changing the setting.

〈Memory Over〉  
All Clear  
**Skip**



## ⑤ Limits

This function memorizes the upper and lower limits and emits a beep to notify the operator when the measurement value exceeds the set upper limit or falls below the lower limit.

(1) Perform steps (1) and (2) on p.13.

(2) To set the limits, move the cursor to the upper limit or lower limit with the ← and → keys, and then press the Del key to clear the entered value. Then newly enter the desired value from the numeric keypad.

■ Limits	Fe
U.L 0251.0	off
L.L 0050.3	off
Esc	μm

Move the cursor to the on/off selection column with the → key, and then move the cursor to **on** with the ↑ and ↓ keys.

■ Limits	Fe
U.L 0255	<b>on</b>
L.L 0050.3	off
Esc	μm

Press the Enter key to set the entered value and return to the measurement screen.

(3) To cancel the limits, select **off** for both the upper limit and the lower limit by pressing the ←, →, ↑, and ↓ keys, and then press the Enter key to cancel these settings and return to the measurement screen.

■ Limits	Fe
U.L 0255.0	off
L.L 0050.3	<b>off</b>
Esc	μm

(4) To leave the settings unchanged, select **Esc** by pressing the ← or → key. Then press the Enter key to return to the measurement screen without changing the settings.

## ⑥ Statistics

This function displays the maximum value, minimum value, calibration deviation, and the average value and sets the data range to be calculated.

To execute Statistics, first set Store prior to measurement (see p. 16).

(1) Perform steps (1) and (2) on p.13.

(2) Move the cursor to the data range numbers with the ↑ and ↓ keys, and then press the Del key to clear the entered values. Then enter the new lower limit value from the numeric keypad. Next, with the → key move the cursor to the blank upper limit field, and enter the upper limit from the numeric keypad.

Statistics
Data No.
0025~013 <u>8</u>
Esc

(3) Press the Enter key to display the number of data in the set range.

Statistics
Data No.
0025~013 <u>8</u>
114Data

(4) Next, press the Enter key to display the various statistics.

Press the Enter key again to return to the measurement screen or the data range setting screen.

Max	269
Min	247
S.D	4.8
AV.	258

**\* If Lot Splitting has been set (see p. 22), the lot number is automatically incremented until Statistics is executed.**

(5) To not execute Statistics, press the → key to select **Esc**. Then press the Enter key to return to the measurement screen without executing Statistics.

## ⑦ Disp. Property

The measurement screen can be selected from [Date/Time] and [Lot/Data No.].

- (1) Perform steps (1) and (2) on p.13.



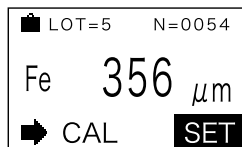
[Date/Time]

- (2) Select either [Date/Time] or [Lot/Data No.] by pressing the ↑ or ↓ key.

Then press the Enter key to apply the setting and return to the measurement screen.



[Lot/Data No.]



- (3) To leave the setting unchanged, select **Esc** by pressing the ↓ key. Then press the Enter key to return to the measurement screen without changing the setting.

## ⑧ Date/Time

The Date/Time can be set.

- (1) Perform steps (1) and (2) on p.13.

- (2) Adjust the Date/Time by pressing the ← and → keys or the ↑ and ↓ keys. Then press the Enter key to apply the settings and return to the measurement screen.



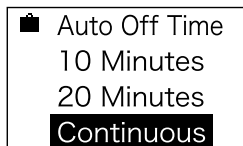
- (3) To leave the settings unchanged, select **Esc** by pressing the ← or → key. Then press the Enter key to return to the measurement screen without changing the settings.

## ⑨ Auto Off Time

The time until the power is automatically switched off in the absence of measurement or key operation can be set (5minutes, 10minutes, 20minutes, or Continuous).

(1) Perform steps (1) and (2) on p.13.

(2) Select the time until the power is automatically switched off (5 minutes, 10 minutes, 20 minutes), or **Continuous** by pressing the ↑ or ↓ key. Then press the Enter key to apply the setting and return to the measurement screen.



(3) To leave the setting unchanged, select **Esc** by pressing the ↓ key. Then press the Enter key to return to the measurement screen without changing the setting.

## ⑩ Brightness

The brightness of the backlight can be set (Off, Dark, Medium, Lightish), allowing the operator to set the optimum brightness for easy viewing according to the ambient brightness.

(1) Perform steps (1) and (2) on p.13.

(2) Select the level of brightness by pressing the ↑ or ↓ key. Then press the Enter key to apply the setting and return to the measurement screen.



**\* Setting the backlight to operate greatly increases the battery consumption and decreases the battery life. It is therefore recommended to set the Lighting Time (see p. 21).**

(3) To leave the setting unchanged, select **Esc** by pressing the ↓ key. Then press the Enter key to return to the measurement screen without changing the setting.

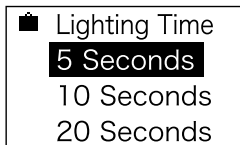
## ⑪ Lighting Time

The lighting time for the backlight can be set to 5s, 10s, or 20s.

\* If "Off" has been set for Brightness (see p. 20), this setting need not be done.

(1) Perform steps (1) and (2) on p.13.

(2) Select the lighting time by pressing the ↑ or ↓ key. Then press the Enter key to apply the setting and return to the measurement screen.



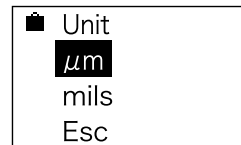
(3) To leave the setting unchanged, select **Esc** by pressing the ↓ key. Then press the Enter key to return to the measurement screen without changing the setting.

## ⑫ Unit

The display unit (μm, mils) for measurement values can be set.

(1) Perform steps (1) and (2) on p.13.

(2) Select the display unit by pressing the ↑ or ↓ key. Then press the Enter key to apply the setting and return to the measurement screen.



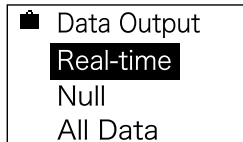
(3) To leave the setting unchanged, select **Esc** by pressing the ↓ key. Then press the Enter key to return to the measurement screen without changing the setting.

### ⑬ Data Output

The measured data can be output to a personal computer or a printer by connecting the optional cable or printer.

(1) Perform steps (1) and (2) on p.13.

(2) Select the data output method by pressing the ↑ or ↓ key. Then press the Enter key to apply the setting and return to the measurement screen.



(3) To leave the setting unchanged, select **Esc** by pressing the ↓ key. Then press the Enter key to return to the measurement screen without changing the setting.

**Real-time** → The data is output simultaneously with measurement. If the settings are changed or Statistics is executed, the new settings or calculation results will be output.

**Null** → Disables the above output.

**All Data** → All the data in the memory, setting changes, results from Statistics execution, and data deletions are output.

### ⑭ Lot Splitting

Lot numbers can be automatically incremented as Statistics are executed.

(1) Perform steps (1) and (2) on p.13.

(2) Select **Auto partition** by pressing the ↑ or ↓ key. Then press the Enter key to apply the setting and return to the measurement screen.



**\*If Auto partition is set, the lot number is automatically incremented at each Statistics execution.**

(3) To deactivate the lot splitting function, select **Off** by pressing the ↑ or ↓ key. Then press the Enter key to apply the new setting and return to the measurement screen.

(4) To leave the setting unchanged, select **Esc** by pressing the ↓ key. Then press the Enter key to return to the measurement screen without changing the setting.

## ⑮ Hold/Continues

Two measurement modes are available, "Hold" whereby the measurement value is displayed statically (fixed value), and "Continues" whereby the measurement value is displayed dynamically (changing value).

(1) Perform steps (1) and (2) on p.13.

(2) Select the measurement mode by pressing the ↑ or ↓ key. Then press the Enter key to apply the setting and return to the measurement screen.



(3) To leave the setting unchanged, select **Esc** by pressing the ↓ key. Then press the Enter key to return to the measurement screen without changing the setting.

\*In the case of "Continues", the measurement value to be displayed is read once it has stabilized after the tip of the probe has been applied to the measurement surface. Therefore, this measurement method allows the obtainment of a relatively stable measurement value when measuring a piece of irregular shape that tends to yield unstable measurement values and Statistics is conducted easier. If the printer is connected, the measurement value can be printed.

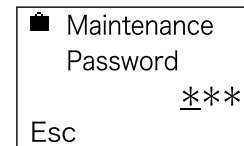
\*In the continues measurement mode, press the enter key when the measurement value has stabilized while placing the probe tip on the measurement surface. The value displayed at that time is recorded as measurement data.

\*Note that the measurement method for calibration differs between the "Hold" and the "Continues" (see p. 30).

## ⑯ Maintenance

The Maintenance mode is used for repair and adjustment. It is not used for daily operation.

(1) If the screen on the right is displayed, select **Esc** by pressing the → key, and then press the Enter key to return to the measurement screen.



## 8. Calibration

### ● Preparations for calibration

Calibration prior to measurement is necessary in order to obtain accurate measurement values from the coating thickness tester. Once calibration has been performed for a given piece, the calibration curve remains in the internal memory and can be called up again, eliminating the need to perform calibration again.

To ensure the highest possible measurement precision, a substrate made with the same material, shape, and thickness as the pieces to be measured, must be used. Calibration is done with "Calibration Method with 4-Point Calibration Foil Set", using an uncoated substrate and calibration foil set (samples of known thickness). Calibrate the unit according to the thickness of the coating to be measured by selecting a combination of substrate and calibration foil by referring to the following chart.

### ● Examples of Zero Base and Calibration Foil Combinations

Measurement Range	5-Point Calibration (Electromagnetic / Eddy-Current)				
0~50μm	Substrate (0μm)	12μm	25μm	38μm	50μm
50~500μm	Substrate (0μm)	50μm	100μm	300μm	500μm
500~2000μm	Substrate (0μm)	500μm	1000μm	1500μm	2000μm <sup>*1</sup>

<sup>\*1</sup>For 2000 μm calibration foil, use 500 μm and 1500 μm foils together.

\*The furnished substrate is simply used to test the precision of the unit.

\*The calibration foils' values are not always those listed in the table above, but are closest to their actual measured values. For calibration foils of other thicknesses, other than those furnished, please contact customer service.









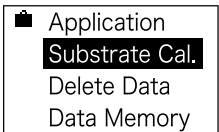


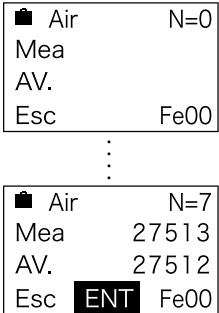
## ● Calibration Procedure




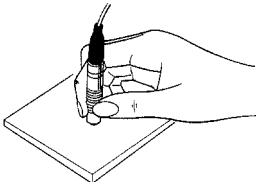





First, set an application number for the application (calibration curve), referring to ①Application on p. 14.

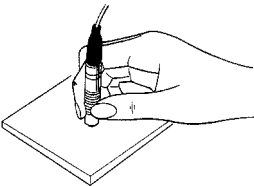
The rest of the procedure is described below.

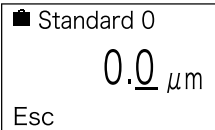
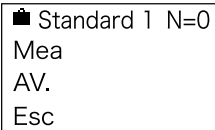
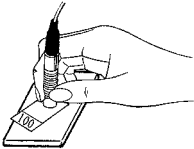
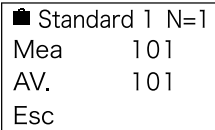
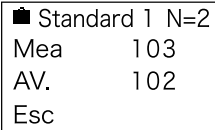
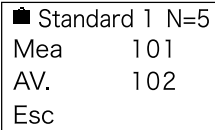
\*Once set, the application number remains in memory even after the power is switched off.

**Procedure Example : Calibration with electromagnetic measurement mode ,  
using a substrate and 4 calibrations foils (100, 300, 500, 700  $\mu\text{m}$ ).**

Step	Operation	Display	Explanation
①	 and 		First, perform substrate calibration. Switch on the power, and then place the cursor over <b>SET</b> by pressing the → key on the measurement screen, and press the Enter key.
②	 or  and 		Place the cursor on Substrate Cal. by pressing the ↑ or ↓ key. Then press the Enter key to switch to the substrate calibration setting screen.
③	Midair measurement  		Point the probe in the air and press the Enter key. Measurement is performed automatically 7 times.



Step	Operation	Display	Explanation
④		<div>  Air N=7  Mea 27513  AV. 27512  Esc <b>ENT</b> Fe00 </div> <div>  Substrate N=0  Mea  AV.  Esc Fe00 </div>	Press the Enter key.
⑤	<p>Substrate measurement</p>  <p>The substrate is measured 7 times.</p>	<div>  Substrate N=1  Mea 36495  AV. 36495  Esc Fe00 </div> <div>⋮</div> <div>  Substrate N=7  Mea 36505  AV. 36501  Esc <b>ENT</b> Fe00 </div>	The substrate is measured 7 times.
⑥		<div>  2012/05/31 10:23  Fe <math>\mu\text{m}</math>   CAL <b>SET</b> </div>	Press the Enter key to return to the initial screen.

Step	Operation	Display	Explanation
⑦	← or →	<div> <div>2012/05/31 10:25</div> <div>Fe <span style="float: right;">μm</span></div> <div>→ CAL SET</div> </div>	Select <b>CAL</b> by pressing the ← or → key. * The display shows the previous measurement mode (Fe or NFe).
⑧	Enter	<div> <div>Standard 0 N=0</div> <div>Mea</div> <div>AV.</div> <div>Esc</div> </div>	Press the Enter key to switch to the calibration display.
⑨	Substrate measurement    The substrate is measured 4 or 5 times.	<div>①</div> <div> <div>Standard 0 N=1</div> <div>Mea 0.1</div> <div>AV. 0.0</div> <div>Esc</div> </div> <div>②</div> <div> <div>Standard 0 N=2</div> <div>Mea 0.0</div> <div>AV. 0.0</div> <div>Esc</div> </div> <div>⋮</div> <div>⑤</div> <div> <div>Standard 0 N=5</div> <div>Mea 0.1</div> <div>AV. 0.0</div> <div>Esc</div> </div>	Measure an uncoated substrate 4 or 5 times. Each time a measurement is completed, a beep sounds and the measured value is displayed.  * The electromagnetic measurement mode is used for ferrous substrates (Fe), and the eddy-current measuring mode is used for non-ferrous metal substrates (NFe).  * Depending on the material, a measurement value that greatly differs from that shown on the left (a measurement value close to 0) may be displayed, but this value will be set to the setting value through steps ⑩ and ⑪, so continue with the operation.

Step	Operation	Display	Explanation
⑩	<p><b>Enter</b></p> <p>and</p> <p><b>Del</b> numeric keypad</p>		Press the Enter key and check that the thickness (0.0 μm) of the substrate coating is displayed. To change the thickness of the substrate coating, delete the value with the Del key, and enter the desired thickness of the substrate coating from the numeric keypad.
⑪	<p><b>Enter</b></p>		<p>Press the Enter key to set the substrate. The display changes from Standard 0 to Standard 1, so the operation goes to measurement using a calibration foil.</p> <p><b>* If <b>Esc</b> is selected on the display during step ⑨ or ⑪ and the Enter key is pressed, substrate calibration is not set.</b></p>
⑫	<p>Measurement of 100μm calibration foil</p>  <p>Place the calibration foil on the substrate and perform measurement 4 or 5 times.</p>	<p>① </p> <p>② </p> <p>⋮</p> <p>⑤ </p>	<p>Place the calibration foil (the 100 μm plastic foil) on the substrate and perform measurement 4 or 5 times.</p> <p><b>*Depending on the material, a measurement value that greatly differs from that of the calibration foil thickness may be displayed, but this value will be set to the setting value through steps ⑬ and ⑭, so continue with the operation.</b></p> <p><b>*Calibration using calibration foils should be done in order of increasing thickness, starting with the thinnest calibration foil.</b></p>

Step	Operation	Display	Explanation
⑬	<div>Enter</div> <div>and</div> <div>Del numeric keypad</div>	<div>Standard 1</div> <div>3000 <math>\mu\text{m}</math></div> <div>Esc</div>	Press the Enter key. Clear the numeric value with the Del key and enter the thickness (100 $\mu\text{m}$ ) of the calibration foil from the numeric keypad.
⑭	<div>Enter</div>	<div>Standard 2 N=0</div> <div>Mea</div> <div>AV.</div> <div>Esc</div>	Press the Enter key to set the calibration foil (100 $\mu\text{m}$ ). The displays changes from Standard 1 to Standard 2.
⑮	Repeat steps ⑫ ⑬ and ⑭ to measure and set the calibration foil (300 $\mu\text{m}$ )	<div>Standard 2 N=0</div> <div>Mea</div> <div>AV.</div> <div>Esc</div>	Proceed to the calibration of the second calibration foil (300 $\mu\text{m}$ ). Check that the screen displays Standard 2, and repeat steps ⑫ ⑬ and ⑭.
	<div>⋮</div> <div>Measure and set the calibration foil (500 <math>\mu\text{m}</math>)</div> <div>⋮</div>	<div>Standard 3 N=0</div> <div>Mea</div> <div>AV.</div> <div>Esc</div>	Proceed to the calibration of the third calibration foil (500 $\mu\text{m}$ ). Check that the screen displays Standard 3, and repeat steps ⑫ ⑬ and ⑭.
	<div>⋮</div> <div>Measure and set the calibration foil (700 <math>\mu\text{m}</math>)</div>	<div>Standard 4 N=0</div> <div>Mea</div> <div>AV.</div> <div>Esc</div>	Proceed to the calibration of the fourth calibration foil (700 $\mu\text{m}$ ). Check that the screen displays Standard 4, and repeat steps ⑫ ⑬ and ⑭.

\* If performing calibration with 4 (substrate and 3 calibration foils) or fewer points, calibrate only the number of calibration foils required, and then after step ⑭, press the Enter key again.

Step	Operation	Display	Explanation
⑫			<p>Press the Enter key to return to the initial display.</p> <p>* If <b>Esc</b> is selected on the display during step ⑫ through ⑮ and the Enter key is pressed, the calibration settings are canceled.</p>

\* The purpose of performing measurement 4 to 5 times for each calibration using a substrate and calibration foils is to obtain the average value.


\* During calibration in the continuous measurement mode (see p. 23), in steps ⑤ ⑨ and ⑫ place the probe tip on the measurement surface, and once the measurement value has stabilized, press the Enter key. The value displayed at that time is recorded as calibration data.

\* If a recent measurement value is displayed on the display, it can be cleared with the Del key.

\* When Esc is displayed on the display, you can return to the display in step ⑦. To do so, press the → key, select **Esc**, and then press the Enter key. In this case, the calibration settings are canceled.

## 9. Battery Replacement

### ● The Battery Alarm

When the battery alarm symbol  is displayed, immediate replace to new batteries (1.5V alkaline AA size, 4 pcs.). Refer to p.10 (1) Insert the batteries.

# 10. Data output format

The 373 series may be connected to either an optipal printer or PC printer to out measurement data or statistical results.

## <Data communications>

RS-232C or USB

## <Interface Specifications>

Baud rate : 115200bps

Data bits : 8 bits

Parity bits : None

Signal Level :  $\pm 5.4v$

## <External Output>

Printer VZ-380 : RS-232C printer cable VZC-60

Personal Computer : RS-232C cable VZC-53 or

VZC-53 and RS-232C-USB converter

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
ASCII code	0x2A	0x4C	0x4F	0x54	0x20	0x30	0x0D	0x0A												
Character	*	L	O	T		O	CR	LF												
ASCII code	0x2A	0x44	0x41	0x54	0x45	0x20	0x32	0x30	0x31	0x32	0x2F	0x30	0x35	0x2F	0x33	0x31	0x0D	0x0A		
Character	*	D	A	T	E		2	0	1	2	/	0	5	/	3	1	CR	LF		
ASCII code	0x2A	0x55	0x2E	0x4C	0x49	0x4D	0x20	0x20	0x20	0x39	0x38	0x36	0x20	0x20	0x20	0x75	0x6D	0x0D	0x0A	
Character	*	U.	L	I	M	T				9	8	6					u	m	CR	LF
ASCII code	0x20	0x4E	0x3D	0x30	0x31	0x39	0x39	0x20	0x20	0x20	0x32	0x35	0x2E	0x30	0x20	0x75	0x6D	0x0D	0x0A	
Character		N	=	O	1	9	9				2	5	.	0			u	m	CR	LF

\* LOT 0

\* DATE 2012/05/31

\* U.LIM 986  $\mu m$

N=0199 25.0  $\mu m$

One digit is consisted of two bytes and contents as per ASCII code table.



# 11. Troubleshooting

Check Items	Verification	Action
Power supply	Are the batteries properly set?	● Open the battery compartment cover at the rear of the unit and check. (See "Insert the batteries" on p.10.)
	Are the batteries exhausted?	● If they are exhausted, replace them with four new size AA alkaline batteries.(See "Battery Alarm" on p.31 and "Insert the batteries" on p.10.)
Probe selection	Has the correct probe been selected?	● Check whether the right probe has been selected for the piece to be measured.(See "Selecting and Connecting the probe" on p.10.)
Probe setting	Is the connector deformed?	● If the connector is deformed, replace it with a new one.
	Is the connector soiled?	● If the connector part has foreign matter on it, clean it by wiping it with a soft cloth dampened with benzene, alcohol, etc.
Probe usage	Is the probe used correctly?	● During measurement, ensure that the tip of the probe is in contact with the measurement surface. (See "Probe usage method" on p.11.)
Symptom	State	Action
The measurement value is not fixed.	The measurement method is set to Continues.	● See "⑮ Hold/Continues" on p.23 and set the method to Hold.
E1 is displayed.	No probe is attached.	● Attach a probe. (See "Selecting and Connecting the probe" on p.10.)
E2 is displayed.	A probe not supported by the unit is attached.	● Attach the correct probe. (See "Selecting and Connecting the probe" on p.10.)
Err----- is displayed.	The measurement value is out of the displayable range.	● Use the unit within its measurement range. (See "Measurable Range" on p.9".)

## 12. Notes for Measuring and Handling

### **(1) Confirm the type of material being measured.**

Be sure to check the type of material and select the correct probe type before beginning measurements.



Caution

### **(2) Do not damage the probe or get it dirty.**

Accurate measurement results cannot be obtained if the chip on the tip of the probe is damaged or dirty. Do not pound the probe against the measurement surface or move the probe laterally while it is pressed down upon the surface. When finished making measurements, use a soft cloth wet with benzine or alcohol to clean the tip of the probe.



Caution

### **(3) Handle the calibration foils with care.**

The thickness of the calibration foils has been measured very precisely. You will not be able to obtain accurate measurement results if you use calibration foils which have been scratched, bent or otherwise damaged. Be particularly careful not to subject the thinnest foil, the 10 $\mu$ m foil, to wear.

If a standard foil becomes damaged while being used, please contact the dealer from whom you purchased the tester and order a replacement of the same thickness. Although the thickness of replacement foils may slightly different than that of the original foils, this does not pose a problem for calibration adjustments.

### **(4) Adjustment & Inspection**

In order to maintain precise performance the coating thickness testers should be inspected at least once per year. Please contact the dealer from whom you purchased your unit regarding inspection.





## ***KETT ELECTRIC LABORATORY***

1-8-1 Minami-Magome Ota-Ku, Tokyo 143-8507 Japan

Tel. +81-3-3776-1121 Fax. +81-3-3772-3001

URL <http://www.kett.co.jp/> E-mail [overseas@kett.co.jp](mailto:overseas@kett.co.jp)