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OPERATING INSTRUCTIONS

Coating Thickness Gauge

MINITEST 1100

and

MINIPRINT 4000 Data Printer

The coating thickness gauges works either on the magnetic induction principle or on the eddy current principle, depending on the type of probe used.

The gauge conforms to the following industrial standards: DIN 50981, 50982, 50984, ASTM B499, B244, ISO 2178, 2360, BS 5411

The industrial standards DIN 50981 and 50984 have been replaced by DIN EN ISO 2178 and DIN EN ISO 2360.

1. General Information

1.1 Applications

This compact, 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 manufacturers and customers, for offices and specialist advisers, for paintshops and electroplaters, for the chemical, automobile, shipbuilding and aircraft industries and for light and heavy engineering.

MINITEST gauges are suitable for laboratory, workshop and outdoor use.

When connected to the MINIPRINT portable printer the gauge can document immediately all readings.

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 aluminium, chrome, copper, zinc, paint and varnish, enamel, rubber etc., on an iron or steel substrate; also on 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.

FN probes work on a combination of the magnetic induction and the eddy current principle. One probe only is required for coating measurement both on ferrous and non-ferrous metal substrates.

All MINITEST 1100 'smart' probes are adaptable as regards specialised tasks; i.e. they can be used for measurements to be taken on specific geometries or on materials with special properties. After storing the relevant details, the probe will automatically adjust to the required conditions.

1.2 Description of the gauge

For measurements on steel, MINITEST 1100 gauge uses the magnetic induction principle. For measurements on non-ferrous substrates it uses the eddy current principle.

Keyboard control can also be transferred to an IBM or compatible PC for **network access** in automated workplaces. .

Measured values and user information are shown on large, easy-to-read LC display. A display back light (optional) ensures easy reading of screen data, in poorly-lit conditions.

1.3 Equipment

Gauge with probe(s), zero plate, calibration standards, alkaline battery and multi-lingual operating instructions.

Optional extras:

- Special-purpose probes
- MINIPRINT 4000, portable data printer with MINITEST serial connecting cable
- Easy access carrying case
- Clear-view gauge cover for protection against dirt and dust
- Combined MINITEST and MINIPRINT case
- Program disk „MSAVE“ for data transfer of single readings to a PC.
- MINITEST -> PC connecting cable (serial) 9 or 25pole
- MINITEST -> Mitutoyo printer connecting cable (serial)
- Precision stand for highly accurate measurements and for measurement on small components
- mains adapter 220V AC/12V DC
- mains adapter 110V AC/12V DC

- accumulator battery and charger, 220V AC or 110V AC

1.4 For quick reference

See inside cover for an explanation of keyboard symbols and examples of commands.

1.5 Probes

1.5.1 Probe construction

All the probe systems (apart from CN02 and special models) are spring-mounted in the probe sleeve. This ensures precise and stable positioning of the probe and even contact pressure. A V-groove in the sleeve of the axial probes facilitates reliable readings on small cylindrical parts.

You should hold the probe by the spring-mounted sleeve (see illustration).

The hemispherical tip is made of hard and durable material.

1.5.2 MINITEST probe types

All probes listed in the following table can be connected to the MINITEST 1100 gauge. Probes are identified by:

- the colour of the protective cover:

Black	=	F probes
Red	=	N probes
Green	=	FN probes (multi-purpose probes)
- the type description and
- an identity number e.g. F2 (A1):

The probe identity number must correspond to the data entered in the gauge memory. Please quote the identity number when ordering replacement probes.

Important: The MINITEST 1100 gauge and the probes are interchangeable. A customer with several MINITEST gauges and probes can therefore combine them as required.

Table of Probe Types

Type	Measuring range	Identity no.	
F06	0...600 μm / 0....24mils	A0	
F2	0..2000 μm / 0....80 mils	A1	iron /
F2/90	0..2000 μm / 0....80 mils	A4	steel
F10	0.....10 mm / 0....400 mils	A6	
F20	0.....20 mm / 0....800 mils	A8	
F50	0.....50 mm / 0....2"	AA	
FN2 FN2/90	0..2000 μm / 0....80 mils	80 82	ferrous & non- ferrous metals
N2	0..2000 μm / 0....80 mils	A3	
N2/90	0..2000 μm / 0....80 mils	A5	non-
N10	0.....10 mm / 0....400 mils	A7	ferrous
N20	0.....20 mm / 0....800 mils	A9	metals
N100	0...100 mm / 0...4"	B1	
CN02	10..200 μm / 0.4...8 mils	B4	

2. Preparing the MINITEST 1100 gauge**2.1. Checking the current supply**

- 1x9 volt alkaline-battery or
1x9 volt accumulator or
a mains adapter

2. Check battery condition by pressing
ON .

- **no LC display:** battery or accumulator missing or battery charge too low to illuminate display

- **no BAT display:** battery is sufficiently charged

- **flashing BAT display, gauge switches itself off after about 1 sec:** replace battery immediately

If the BAT display flashes during measurements, the battery is running low and should be replaced before the gauge is switched on next time. If not, the LC display will show the flashing BAT warning and the gauge will switch itself off after about a second.

Note that the gauge will not make faulty measurements even if the voltage is very low.

2.2 Replacing the battery

1. Place the gauge upside down on a suitable surface.
2. Remove the screws from the battery compartment with a crosstip screwdriver.
3. Raise the lid of the battery compartment.
4. Remove battery.
5. Insert new battery.

Caution:

Make sure the positive and negative poles are correctly positioned.

If not, all data saved to memory will be lost.

An interval of more than 10 seconds between removing the old battery and inserting the new one will also result in the loss of data (readings, calibration values, basic gauge settings).

6. Screw on the battery compartment lid securely.

2.3 Selecting a probe

Select a probe according to the task in hand, connect it and screw in place. (See also Technical Data.)

2.4 Start-up functions and basic gauge settings

The MINITEST 1100 gauge includes a number of functions that can only be called up or activated during start-up.

Table of start-up functions:

Function	Key combination
Total reset	FUNC+CLEAR+ON
LCD test	↑-key + ON
Basic gauge settings *	FUNC + ON

* 2.5 Table of basic settings

2.4.1 Total reset

A total reset erases the last measuring value and all calibration values. The basic gauge will resume the basic MODI-setting (FUNC - : / **Q**, see section 2.5, table of basic settings).

A probe must be attached before reset.

1. Switch off gauge.
2. Press CLEAR-, FUNC- and ON simultaneously. Total reset is confirmed by a long bleep.

2.4.2 LCD segment test

The LCD segment test enables all sections of the LC display to be inspected and checked.

1. Switch off the gauge.
2. Hold down the \hat{u} -key, press ON and keep both keys depressed until the bleep sounds. As long as the arrow key is depressed, all sections of the LC display will be shown.

2.5 Basic gauge settings

1. Switch off the gauge, hold down the FUNC key and press ON.
2. Keep both keys pressed until you hear the signal. The gauge will now display a pair of numbers: 1:0 or 1:1.

Note:

If you are using the multi-purpose probe FN2, use the arrow keys to activate the F function (\hat{u}) or the N function (\hat{v}).

3. Press FUNC to move through each of the table's function from 1 to 8. Use the arrow keys to set the option 0/1.
4. Press FUNC again to return to measuring mode.

Table of basic settings

FUNC		Mode setting	
1	0	Measuring unit	metric/ mm
	1		Imperial / inch
2	0	Switch-off mode	short-term mode
	1		long-term mode
3	0	Data format	floating decimal point
	1		fixed decimal point
5	0	Input to printer or PC	key-operation
	1		continuous
6	0	Await stable reading *	stable reading
	1		every reading
7	0	Key lock function for ZERO and CAL	Off
	1		Keylock
8	0	Display light (Option)	inactive
	1		active

2.5.1 Select a measuring unit: 'metric' - 'inch' (Imperial)

To switch from metric units (μm , mm, cm) to Imperial (mils, inch) or vice versa, proceed as follows:

1. Switch off gauge.
2. Hold down the FUNC key and press ON.
3. Keep both keys depressed until you hear the bleep. The gauge will now display a pair of numbers: 1: 0/1.
4. Use the arrow keys to adjust to the required measuring unit. 0=metric, 1=Imperial.
5. Press FUNC 8 times. The gauge is now ready for use.

2.5.2 Switching between short-term and long-term mode

The gauge is programmed to switch itself off after about 90 seconds. This can hinder operations in certain circumstances. In this case the operator should transfer to the alternative long-term mode.

To switch the gauge to long-term mode, please refer to the table of gauge settings in section 2.5. Adjust to the new mode

with the FUNC and arrow keys as described.

2.5.3 Floating decimal point / fixed decimal point option.

The standard data format of readings transferred via the combination interface uses the floating decimal point. For data loggers etc. this default setting can be changed to a fixed decimal point.

In the fixed decimal point option, all metric readings in microns will be displayed to one place after the decimal point. In Imperial units readings in mils will be displayed to two places after the decimal point.

To switch between fixed and floating decimal point options, please refer to the table of gauge settings in section 2.5. Adjust to the new mode with the FUNC and arrow keys as described.

2.5.4 KEYLOCK Function for ZERO and CAL keys. (Locks calibration keys)

An accidental recalibration or unintentional offset input can be prevented by using the KEYLOCK function.

To activate the KEYLOCK function please refer to the table of gauge settings

in section 2.5. Select option with the FUNC and arrow keys as described.

2.5.5 Activating/deactivating the LC display light (optional)

An LC display lamp can be supplied as an optional extra. When activated it lights the display for about 2 sec. after a reading has been taken. Please remember that using the lamp requires extra current, so if necessary keep a spare battery to hand.

To activate the display light please refer to the table of gauge settings in section 2.5. Select option with the FUNC and arrow keys as described.

2.5.6 Switching between single measurement and continuous measurement mode

It can sometimes be of advantage (measurement inside pipes) if the probe does not need to be raised between each measurement so that there is a running display of readings.

1. Switch on gauge.
2. Press FUNC, then CONTINUE-key. A short bleep confirms the change of mode.
3. When the measuring unit (μm , mm, cm) flashes it means that the continuous mode is in use. Measurements outside the measuring range will be indicated by four lines (- - - -). In continuous measurement mode, readings are not accompanied by a bleep and the optional display lamp is deactivated.
4. To print-out readings on a printer (optional extra) or to transfer readings to a PC via the interface, press the arrow key (\uparrow) or push the foot-operated switch (optional extra).
5. Return to standard mode (i.e. single measurement mode) either by repeating steps 1 and 2 or by switching the MINITEST off and on again. (Switching OFF and ON again to return to single measurement mode does not apply to the pipe measuring probe and N100 probe).

3. Calibration and measurement

3.1 General remarks on calibration

3.1.1 Methods of calibration

Four different calibration methods are available for the MINITEST 1100 gauge:

- Standard calibration
recommended for even surfaces and for approximate measurements, i.e. those that do not require the degree of accuracy of one-point calibration.
- One-point calibration:
set zero without foil
recommended when measuring errors up to 3% of reading plus the probe's constant error are permitted.
- Two-point calibration:
set zero and calibrate with one foil
recommended if a tolerance of 1% - 3% plus the probe's constant error is acceptable.
- Two-point calibration:
set zero and calibrate with two foils:
recommended when:
 - a) taking readings on rough surfaces.
 - b) exact measurements are required on smooth surfaces whose thick-

ness lies between that of the two calibration foils.

Note:

The term calibration foil applies to all calibration standards, including those not normally described as 'foil': e.g. those with thickness of 2mm / 80 mils; 5mm / 0.2"; 10mm / 0.4".

3.1.2 Saving calibration values

If the gauge is calibrated for a particular purpose, the calibration values will be logged in memory until changed. (See also section 3.1.8, Stabilisation of calibration values).

If a calibration is to be altered using the same probe, simply carry out a new calibration. This automatically deletes the previous calibration values and saves the new ones for immediate use.

Note:

Calibration cannot be continued if during the calibration procedure:

- an incorrect reading is taken
- an incorrect command is entered
- the gauge is for any reason switched off

Restart the procedure from the beginning

3.1.3 Example of calibration

Calibration is the most important requirement for accurate measurement. The more closely the calibration sample matches the product sample, the more accurate the calibration, and therefore the reading, will be.

Example:

If measurement is to be taken on a steel cylinder, quality ST37 (mild steel), \varnothing 6 mm / 0.24" dia, calibration must be carried out on an uncoated steel cylinder of similar quality and with the same diameter.

The calibration sample must correspond to the product sample in the following ways:

- in the radius of curvature of the surface
- in the characteristics of the substrate
- in the thickness of the substrate
- in the size of the area to be measured

For further details please refer to the technical specification.

The point at which the calibration is made on the calibration sample must always be identical with the point of measurement

on the product itself, especially in the case of corners and edges of small components. The precision stand will prove invaluable here.

3.1.4 The effects of substrate thickness

In the case of steel parts, the thickness is of no consequence as long it is greater than the general measuring range of the probe in use.

In the case of non-magnetic metals, it is sufficient if the substrate is 40 microns / 1.6 mils thick and strong enough not to give way under the pressure of the probe tip. A thin layer of aluminium foil can be suitable, if stuck on a hard base.

The enclosed steel and aluminium zero plates are for test purposes only and are not generally recommended for calibration.

Exceptions:

The zero plates may be used for calibration if the product sample has a smooth, even surface (not shot-blasted) and

- if steel parts are thicker than 1mm. In this case, the zero plate may be used for calibration by laying it on the coated sample to be measured.

- if aluminium parts to be measured are thicker than 40 microns / 1.6 mils. In this case the enclosed aluminium foil may be used for calibration. (Thin layers of aluminium foil should be stuck to a hard base.)

3.1.5 High-accuracy calibration

To achieve high-accuracy readings, it is advisable to log calibration values (both zero values and calibration foil values) several times in succession. In this way the gauge will automatically establish a mean calibration value. For more details see sections 3.2.2-3.2.9 on calibration.

This method is an obvious advantage when calibrating on uneven, e.g. shot-blasted, surfaces.

3.1.6 Cleaning the measuring point

Before calibration the measuring point, and the probe tip must be free from grease, oil, scraps of metal, et. The slightest impurity will affect measurement and distort readings.

3.1.7 Acoustic signal

Whether the probe is being used for calibration or for measurement, it must be held in place and not lifted until the bleep sounds.

3.1.8 Stabilisation of calibration values.

No recalibration is necessary in changeable external conditions, e.g. variations in ambient temperature, as the gauge automatically takes these into account (see Technical Data)

3.2 Points to remember when calibrating

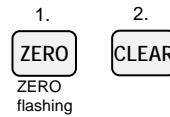
When calibrating according to sections 3.2.2 to 3.2.11, the basic procedure is always as follows:

1. Start calibration by pressing the appropriate calibration key (ZERO or CAL).
2. Apply the probe to the calibration foil.
3. End calibration by pressing the calibration key again (ZERO or CAL).

See also the keyboard symbols and Quick Reference Table at the end of this instruction booklet.)

3.2.1 Activate standard calibration

For use with all probes except the CN02.



1. Press ZERO.
2. Press CLEAR.
3. Take readings.

The standard calibration stored in the gauge should only be used for measurements on even surfaces, i.e.

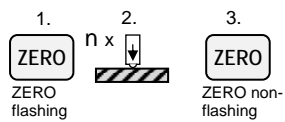
- a) on steel components made of conventional construction steel (mild steel).
- b) on aluminium components.

Note:

Make sure there is sufficiently good zero indication on an uncoated test sample. If not, one-point or two-point calibration must be carried out.

3.2.2 One-point calibration without foil (zero only)

Applicable to all probes (except CN02).



1. Press ZERO to initialise ZERO calibration. The display will show ZERO (flashing) and MEAN (not

flashing). MEAN indicates that the mean value of the readings will be shown on the display.

2. Place the probe on uncoated sample (zero coating thickness) and raise it after the bleep.

Place the probe on the uncoated sample several times. The display always shows the mean value of the previous readings.

To discontinue ZERO calibration, press CLEAR.

3. Press ZERO. The word ZERO will appear on the display (not flashing)
4. Now take readings by placing the probe on the coating to be measured and raise it after the bleep.

Read off the thickness value.

5. It may be necessary to delete the ZERO calibration if, for example, an incorrect zero value is entered. In this case:

- a) press ZERO then CLEAR to delete the zero calibration and any existing CAL calibration.

Note:

This will reactivate the default

standard calibration for use on even surfaces.

- b) or restart ZERO calibration by repeating steps 1 to 3 above. This automatically deletes the old calibration and saves the new calibration

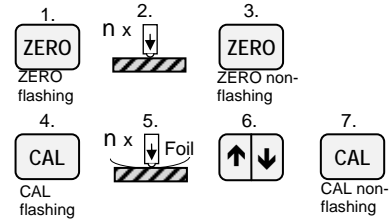
Note:

ZERO calibration deletes an already existing CAL calibration.

3.2.3 Two-point calibration (ZERO with one calibration foil)

Applicable to all probes (except CN02)

This method is recommended for high precision measurement and for measurement on small components and hardened and low-alloy steels.



1. Press ZERO to initialise ZERO calibration

The display will show ZERO (flashing) and MEAN (not flashing). MEAN indicates that the mean value of the readings is shown on the display.

2. Place the probe on an uncoated sample (zero coating thickness) and raise it after the bleep.

Place the probe on the uncoated sample several times. The display always

shows the mean value of the previous readings.

To discontinue ZERO calibration, press CLEAR.

3. Press ZERO. The word ZERO (not flashing) will appear on the LC display
4. Press CAL to initialise foil calibration.

The display will show CAL (flashing) and MEAN (not flashing). MEAN indicates that the mean value of the readings is shown on the display.

5. Lay the calibration foil on an uncoated sample, apply the probe and raise it after the bleep.

The thickness of the foil should be roughly equivalent to the estimated coating thickness.

Apply the probe to the test sample several times. The display always shows the mean value of the previous readings. To discontinue calibration, press CLEAR.

6. Adjust to the thickness of the foil with the arrow keys.
7. Press CAL. CAL will appear on the display (not flashing).

8. Now take readings by placing the probe on the coating to be measured and raising it after the bleep.

9. It may be necessary to delete the CAL calibration if, for example, an incorrect calibration is entered. In this case:

- a) Press CAL then CLEAR to delete the CAL calibration and any existing ZERO calibration.

Note:

This will reactivate the stored default standard calibration for use on even surfaces.

or

- b) restart CAL calibration by repeating steps 4 to 7 above. This automatically overwrites the old calibration and saves the new values.

Special remarks for probe types F10 and F20: If these probes are to be used on metal coatings, it is essential to use two-point calibration. The calibration standards must be of the same metal as the coating to be measured.

3.2.4 Calibration and measurement with the universal FN2 probe

The FN universal probe can work on both the magnetic induction and the eddy current principle.

To select the measuring procedure, press ON. The word FERROUS will flash on screen. Press the \uparrow -key to select FERROUS, i.e. the magnetic induction method.

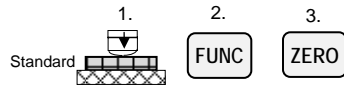
Press the \downarrow -key to select NON-FERROUS, i.e. the eddy current method. If the neither key is pressed, the gauge will automatically display FERROUS after about 5 sec. and select the magnetic induction method.

For calibration and measurement, proceed as normal according to either 3.2.2 or 3.2.3..

3.2.6 Calibration and measurement with N10 and N20 probes

During calibration with N10 and N20 probes the dielectric characteristics of the calibration standard and of the coating material must be taken into consideration.

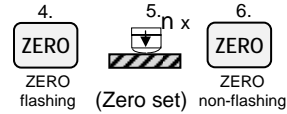
1. Standardisation

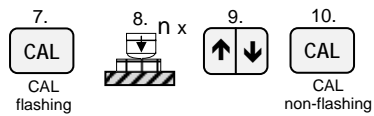


Place the probe on the thicker of the two supplied standards, without any metal underneath. To avoid any external dielectric influences, an effective base for the standard is a polystyrene block at least 3cm in thickness. Press FUNC and then ZERO.

2. Zero and calibration

For calibration and measurement proceed as normal in 3.2.2. or 3.2.3..





(Calibration as in 3.2.3)

3. Eliminating the effects of dielectric influence of the coating material.

Place the probe on the coating material without a metal base.

Press FUNC and then ZERO.



Note : This deactivates the automatic temperature compensation feature. Recalibrate in case of changes in temperature.

3.2.6 Calibration and measurement with N100 probe.

For wall or coating thickness measurement with N100 probe, the base material can be of ferrous or non-ferrous metal.

The metal base must be a minimum 30 x 30 cm / 12" x 12".

With smaller areas, the measuring tolerance might be greater than specified in the table provided. However, the area must not be smaller than 15 x 15cm / 6" x 6".

For minimum error the following is recommended:

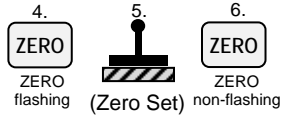
For calibration choose a spacer whose thickness is similar to the expected material thickness (see following calibration principle).

1. Switch on the gauge. After switch-on, the gauge goes to continuous mode automatically as this has many advantages when measuring wall thickness.

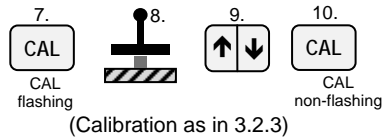
The flashing measuring unit (μm , mils) indicates that the continuous mode is in use. Measurements outside the measuring range will be indicated by four lines (- - -).

2. Standardisation

Hold the probe in the air and press FUNC and ZERO.

3. Zero Set

Place the probe on an uncoated surface and press ZERO. ZERO flashes on the display and there is a repeated bleep. Press ZERO again. ZERO stops flashing and the bleep stops. The display shows 0.0mm / mils.

4. Calibration

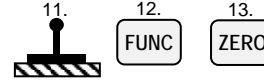
(Calibration as in 3.2.3)

Place the spacer supplied (e.g. 50 mm / 2") in the recess in the base of the probe. The thickness of the spacer should be similar to that of the expected thickness to be measured.

Place both together on the reflective foil. The probe base must be held parallel to the foil.

Press CAL.

CAL flashes and there is a repeated bleep. Adjust to the spacer thickness with arrow keys. Press CAL again and CAL stops flashing.

5. Eliminating the effects of dielectric interference of the coating material.

After entering calibration values, the probe must be placed on the material (minimum thickness 30mm / 1.2") but without a metal base.

Now press FUNC and ZERO one after the other.

6. The gauge is now ready for measurement.

Note: It is recommended that you check and repeat the calibration occasionally:

1. After more than two hours.
2. After high temperature changes - more than 10°C / 18°F.
3. When the gauge is to be used on other types of material, point 5. „Eliminating...“ must be repeated

3.2.7 Calibration and measurement with probe F20

Switch on gauge with probe connected. After switch on, the gauge goes to continuous mode automatically as this mode has many advantages when using the F20 probe.

The flashing measuring unit (μm , mm, mils) indicates that the continuous mode is in use. Measurements outside the measuring range will be indicated by four lines: (- - -).

Hold the probe in the air and press FUNC and ZERO. This ensures that, temperature and drift influences are compensated.

After the bleep, gauge and probe can be calibrated. For that, please note chapter 3.1 and 3.2.

Place probe on the coating to be measured and if required, transfer the reading to the printer or to a PC via the interface by pushing the \hat{u} button.

4.2.8 Calibration and Measurement using F50 Probe.

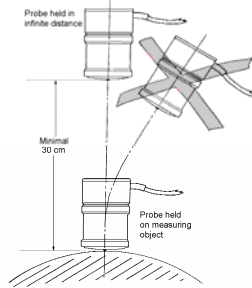
Notes on calibration and measurement using F50 probe in conjunction with MINITEST 1100:

Use the calibration and measurement routines described in either 3.2.2 or 3.2.3.

The probe position has an impact on the measuring result. The infinite value automatically taken by the instrument or probe must be taken from the same angle to the measuring object as the reading which is to be taken later on. Further, the probe must be moved at a constant speed towards the measuring object.

In order to eliminate hysteresis errors, after each measurement, the probe must be held away from the measuring object

ensuring a minimum distance of 0.3m



away from any metal parts.

Note:

The magnetic field created by the measuring probe might interfere with electronic equipment or gauges in the vicinity or even destroy such instruments. To avoid such interference, it is recommended to keep a distance of at least 1m away from computers, monitors or any other magnetic data carrier.

using the pipe probe. The flashing measuring unit (μm , mm, mils) indicates that the continuous mode is in use. Measurements outside the measuring range will be indicated by four lines (- - -).

1. Use the calibration and measurement routines described in either 3.2.2 or 3.2.3. Calibrate in single measurement mode.
2. Place the probe on the coating to be measured. After taking the readings, the gauge automatically calculates the mean values. If required, transfer the reading to the printer (optional) or to a PC via the interface by pushing the \hat{u} button.

3.2.9 Calibration and measurement with pipe probes F2/90 and N2/90

After switch on, the gauge switches to continuous mode automatically, since this mode has many advantages when

3.2.10 Calibration and measurement of chrome coatings on copper, aluminium or brass

Applicable to probe type N2/90; requires a special calibration foil.

1. The two-point calibration method described in 3.2.3 must be used..
2. Use one of the special calibration foils marked 'Chrome on Cu', 'Chrome on AL', or 'Chrome on Brass'.

3.2.11 Calibration and measurement with probe CN02

The CN02 is a flat probe for use on even surfaces only.

Only one-point calibration using one foil is required.

To measure the thickness of copper laminates or copper foil:

1. Press CAL to initialise calibration

The LC display will show CAL (flashing) and MEAN (not flashing). MEAN indicates that the mean value of the readings will be shown on the display.

2. Place the metallic calibration foil on an insulating piece of minimum 10mm

thickness uncoated sample, apply the probe and raise it after the bleep.

The thickness of the foil should be roughly equivalent to the estimated thickness of the sample to be measured.

Apply the probe to the metallic calibration foil several times. The display always shows the mean value of the previous readings.

To discontinue calibration, press CLEAR.

3. Adjust to the thickness of the foil with the arrow keys.
4. Press CAL. CAL (not flashing) will appear on the LC display.
5. Now take readings by placing the probe on the coating to be measured and raising it after the bleep.

Important:

- Measurements on double-sided laminated PC boards will require calibration using a double sided laminated copper standard.
- Measurements on non-ferrous metal foils other than copper:

Proceed as normal with calibration as in steps 1 to 5. The calibration standards must be made of the same metal as the actual coating. (please consult the manufacturer if in doubt.)

3.2.12 Calibration and measurement on blasted surfaces.

The physical nature of blasted surfaces results in coating thickness readings that are too high. The mean thickness over the peaks can be determined as follows:

Method A

1. The gauge should be calibrated according to the method described in 3.2.2 or 3.2.3. Use a smooth surface with the same curvature radius and the same substrate.
2. Now take approx. 10 readings on the uncoated, blasted surface to evaluate the mean \bar{X}_o .
3. After this take approx. 10 readings on the coated and similarly blasted test sample to evaluate the mean value \bar{X}_m .
4. The difference $(\bar{X}_m - \bar{X}_o) \pm s$ is the mean coating thickness over the

peaks; s is the greater standard deviation of the two values \bar{X}_m and \bar{X}_o .

Method B

This method should be used for surfaces with a roughness grade of $\leq R_z \leq 20\mu\text{m}$ / 0.8 mils.

1. Carry out a zero calibration of 10 readings on a blasted, uncoated substrate. Then calibrate with a foil on the uncoated substrate. The foil value comprises a number of individual foils of max. 50 microns / 2 mils thickness each and should roughly correspond to the estimated coating thickness.

The coating thickness can be read directly and should be averaged from 5...10 single measurements.

Note:

for coating thickness over 300 microns / 12 mils, the degree of surface roughness is no longer important so that it is not necessary to apply the above methods.

3.2.13 Adjusting the basic calibration

In certain cases it can be of assistance or even imperative to change the primary probe calibration e.g.

- if the probe tips are worn
- for special applications (if necessary consult the manufacturer)

The primary calibration should be carried out with special software (optional extra) via a PC.

3.3 General remarks on measurement

After careful calibration has been made all subsequent measurements will lie within the guaranteed measuring tolerance (see technical data).

Strong magnetic fields near output transformers or live rails with strong currents can interfere with the reading.

The final reading derives from:

1. the statistical calculations and
2. the guaranteed tolerance levels of the gauge .

Example:

Th (coating thickness) = $\bar{X} \pm s \pm u$

\bar{X} = mean = 153 μm / 6.1 mils

s = standard deviation
= $\pm 3 \mu\text{m}$ / 0.12 mils

u = tolerance of the gauge

= $\pm(1\% + 1 \mu\text{m}) = \pm(1,5 \mu\text{m} + 1 \mu\text{m})$
= (0.06 mils + 0.04 mils)

Th = 153 $\mu\text{m} \pm (3 + 1,5 + 1) \mu\text{m}$

= 153 $\mu\text{m} \pm 5,5 \mu\text{m}$

Th = 6.1 mils $\pm (0.12 + 0.06 + 0.04)$
mils

= 6.1 mils ± 0.22 mils

Example:

$\pm (1\% \text{ of reading} + 1 \mu\text{m})$

Th = 153 $\mu\text{m} \pm 5.5 \mu\text{m}$

4. 'Delete' functions

4.1 Deleting the last reading taken:

CLEAR

Press the CLEAR-key once immediately after a reading has been taken. A short beep confirms the reading has been deleted.

On the print-out and/or on the PC „Cancel“ will be shown and the reference number of the reading will continue from the previous reading.

4.2 Deleting current calibration and adjusting to standard calibration

ZERO

CLEAR

1. Press ZERO.
2. Press CLEAR
3. A short beep confirms calibration has been deleted.

4.3 Deleting current calibration and total reset to basic setting

CLEAR

FUNC

ON

1. Switch off gauge.

2. Press CLEAR, FUNC and ON subsequently and keep all keys pressed. A long beep confirms that all data have been deleted.

5. Using the gauge without probe

Certain gauge functions such as defining initialising function and standard gauge settings can be activated without a probe being connected.

6. The MINIPRINT 4000 data printer

The portable MINIPRINT 4000 printer is fitted with a built-in rechargeable battery. The power pack supplied with the gauge is sufficient to run the printer and recharge the battery. A fully charged battery will last for several thousand lines of print.

The MINIPRINT 4000 printer will provide an instant print-out of single values.

1. Connect printer with MINITEST gauge.
2. Press ON-LINE to activate the MINIPRINT.
3. Now switch on the MINITEST gauge (ON).
4. Take reading. The indicated reading will be printed out with a current reference number. After each switch

on, the current reference number starts with „1“.

Please note:

All MINITEST gauge functions are blocked as long as printing is in progress.

The printer will stop working if OFF-LINE is pressed.

As the printer only requires power while it is printing out, it need be not switched off when not in use.

When the MINITEST switches itself off automatically, the printer status -either ON-LINE or OFF-LINE- will remain in memory. When the gauge is switched on again the printer will resume its previous status.

The paper feed (FEED) does not function unless both the MINITEST and MINI-PRINT are switched on.

When recharging the built-in batteries, do not exceed a charging time of 14 hours.

6.1. Changing the paper roll

1. The MINITEST and the MINIPRINT should be connected.
2. Switch on the MINITEST.
3. Activate the MINIPRINT with ON-LINE.
4. Press FEED to remove any remaining paper.
5. Cut off the end of the new roll cleanly and insert the end into the slit at the bottom while pressing FEED.
6. The printer mechanism will now draw the paper through.
7. Slip the new paper roll on the plastic shaft into the slots of the 2 supports.

6.2. Changing the printer ribbon

As the printer ribbon is mounted as a loop in a plastic cartridge, it can easily be removed from the printer.

1. First remove any paper in the printer.
2. Remove the 4 screws from the back panel.
3. Carefully pull the top of the casing forward to uncover the printing mechanism and the cartridge.

4. Locate the point on the right marked PUSH and press. This releases the other end of the cartridge from the cog pin.
 5. The cartridge may now be removed without difficulty. A new cartridge can be inserted by reversing the instructions above.
 6. Tighten the ribbon by turning the notched knob of the new cartridge in the direction of the arrow.
 7. Tilting the cartridge slightly, slip it over the cog pin.
 8. Clip in the other end, making sure that the ribbon is taut and fed horizontally into the paper slot.
- 7. Connecting a PC(IBM and compatible)**
- The MINITEST 1100 / 2100 and 4100 gauges have a combination interface which can accommodate a MINIPRINT 4000 data printer, a Mitutoyo system evaluator and two-way RS232C interface. The connecting cable and the data transfer program can be used to transfer all readings and statistics to a PC for further processing. The data transfer procedure is the same as that for data print-out.
- 8. Gauge control using a PC**
- The two-way interface can be used to control MINITEST gauge functions via:
- a PC keyboard
 - a PC program
- The option of program control enables the gauge to be used both for semi-automatic and fully automatic operation. For further details consult our special leaflet.
- 9. Combination interface for foot-operated switch, bleeper or lamp (optional)**
- This optional interface makes available:
- an external trigger mechanism which enters readings in the continuous mode of the pipe probe into the statistics program by a foot-operated switch.
 - a reading confirmed signal for a bleeper or a lamp. Length of reading confirmed signal: 0.2 sec.
- 10. Interface details for the MINITEST and MINIPRINT**
- A full description will be provided on request.
- 11. Useful accessories**
- Special-purpose probes

- In-service carrying case
- Clear-view cover for dust protection
- Double case for MINITEST and MINIPRINT
- MINIPRINT 4000, portable printer
- Connecting cable MINITEST / PC
- Program disk: „MSAVE“ to transfer single readings to a PC.

12. Maintenance and maintenance contracts

The MINITEST needs an occasional battery change but is otherwise maintenance-free. It is extremely robust, but, as with any measuring apparatus, it should be handled with care. Used batteries must be removed from the gauge without delay. The accumulator batteries in the MINIPRINT printer need regular recharging.

If the customer takes out a **maintenance contract** the gauge and all supplementary hardware will be serviced annually. We will gladly supply an estimate for maintenance agreement with further details of the service guarantee.

13. Customer service

Please send a damaged or defective gauge to us directly or forward it via your dealer.

We should be grateful if you could enclose a brief description of the fault.

14. Other gauges and testing instruments

We supply a range of coating **thickness gauges** for

- non-magnetic or nickel coatings on steel using the magnetic attraction principle (MIKROTEST type)
- paint and varnish on wood, plastics, ceramics, glass, et., (MINITEST 400)
- galvanised coatings on all substrates using the coulometric principle (GALVANOTEST type) and the X-ray fluorescence principle (XRF2000 type).
- Plastic foil, artificial leather, sheets, etc., using the continuous magnetic induction principle (CTM 2000 and CTM 3000 type).

We also supply **porosity detectors** (POROTEST type) for:

- insulating coatings on all metals
- insulating coatings on concrete

15. Trouble-shooting

The following list of error messages explains how to identify and eliminate faults. „E" (E = error).

Faults that cause the gauge to switch off:

- E01 Probe type incompatible.
- E02 Probe not connected. This message only appears when no probe is connected after a total reset.
- E03 Probe defective. This message only appears immediately after the gauge is switched on or if the probe becomes detached from the socket while in use.
- E04 Probe is giving unreliable readings (e.g. as a result of strong fluctuations in the magnetic field or readings taken on soft coatings)
- E05 Probe was held to near metal when switched on
- E06 Battery voltage too low.

Error messages displayed for about 1.5 secs:

E12 ZERO calibration not possible.

If faults occur without an error message appearing, e.g.:

- the gauge does not switch itself off automatically
- readings are no longer registered
- the keyboard does not function properly
- readings illogical

The quickest remedy is a total reset!

1. Switch off gauge.
2. Holding down FUNC and CLEAR, press ON. A long bleep confirms that the last reading and all calibration have been deleted. The gauge is reset to standard setting.

If the gauge cannot be switched off from the keyboard, remove the battery for a short time before carrying out a total reset.

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17. Example of how to operate the MINITEST 1100

Connectable probes:
F2; F2/90; F10
N2; N2/90; N10
FN2 (universal probe)

also required:
steel or aluminium zero plate;

- 1. Insert and screw in probe**
- 2. Press ON.**
-According to probe type, the display will show FERROUS or NON-FERROUS and μm or mm.
- 2a. Exception: the universal probe FN2:**
-FERROUS flashes on the display.
-For measurements on iron and steel: Press ($\hat{\uparrow}$).
FERROUS appears with μm or mm.
-For measurements on non-ferrous metals: press ($\hat{\downarrow}$) within 4 sec.
NON-FERROUS appears with " μm " or "mm". (If necessary switch off the gauge and start again).
- 3. Press ZERO.**
-ZERO flashes on the display

- 4. Place the probe on the zero plate several times.**
-F probes on the enclosed steel standard.
-N probes on the enclosed aluminium standard.
-FN probes either on the steel or aluminium standard.
- 5. Press ZERO.**
-The display will show ZERO.
- 6. Now start measurement.**
E.g. take a calibration foil, lay it on the zero plate and place the probe on it several times.
The gauge will now display the calibration foil thickness, taking into account gauge tolerances.
For increased accuracy calibrate again with one of the calibration foils.
- 7. Press CAL**
-The display will show CAL.
- 8. Place one of the enclosed calibration foils on the zero plate and apply the probe several times.**
- 9. Adjust to the thickness of the foil with the arrow keys.**

10. Press CAL.

-The display will show ZERO and CAL and μm or mm.

11. Now start measurement.

E.g. as described under 6.

End of sample instructions for the MINI-TEST 1100.

For further details, please look up the point you wish to clarify by referring to the Contents (at the front) or the Index (at the back) of the operating instructions.

Metric Units

Technical data on probes for use with the MINITEST

Probe	F 06	F 2	F 2/90	F 10	F 20	F50	FN 2 for steel and non-ferrous substrates	N 2	N 2/90	N 10	N20	N 100 insulating coatings on steel AND on non- ferrous substrate	CN 02 non-ferrous metal coatings on insulating substrates
Principle	magnetic induction							Eddy current					
Measuring range	0...600µm	0...2000µm	0...10mm	0...20mm	0...50mm	0...2000µ (0...40µm Cr on Cu)			0...10mm	0...20mm	0...100mm	10...200µm	
Low range resolution	0.1µm	0.2µm	5µm	10µm	10µm	0.2µm			10µm	10µm	0.1mm	0.2µm	
Guaranteed ²⁾ tolerance	¹⁾ Tolerance percentage based on measured value ¹⁾ ± (1..3% + 0.7µm) ± (1..3% + 1µm) ± (1..3% + 10µm) ± (1..3% + 25µm) ± (3% + 50µm) ± (1..3% + 1µm) ± (1..3% + 25µm) ± (1..3% + 50µm) ± (1..3% + 0.3mm) ± (3% + 1µm)												
Minimum curvature radius	convex 1.5mm	1.5mm	flat	5mm	10mm	50mm	1.5mm	flat	25mm	25mm	100mm	flat	
	conkav 5mm	10mm	6mm	16mm	30mm	200mm	10mm	10mm	100mm	100mm	flat	flat parts only	
Minimum area for measurement	3mm dia	5mm dia	5mm dia	20mm dia	40mm dia	300mm x 300mm	5mm dia	5mm dia	5mm dia	50mm dia	70mm dia	150mm dia	7mm dia
Minimum base thickness	0.2mm	0.5mm	1mm	2mm	2mm	F: 0.5mm N: 50µm	50 µm					no limit	
Dimensions in mm	12 dia x 56	15 dia x 62	18 x 9 x 170	28 dia x 48	44 dia x 65	45 dia x 71	15 dia x 62	13 x 15 x 160	50 dia x 72	65 dia x 75	126 dia x 155	16 dia x 68	
Power supply: 1 x 9 V alkaline battery (more than 10.000 measurements), adapt NiCd-battery, mains adapter							Ambient temperature: gauge 0...50 °C; probe -10°C...+70°C, briefly to 120°C						
Standards: DIN 50981, 50982, 50984 / ISO 2178, 2360 / BS 5411 / ASTM B499, B244							Dimension / weight of gauge: 150mm x 82mm x 35mm 270g						

¹⁾ Better tolerance can be obtained if gauge is calibrated with standard of expected thickness.

²⁾ Based on manufacturer's standards.

³⁾ A two-point calibration becomes necessary if several minimum requirements are applicable (minimum curvature radius and/or minimum area for measurements and/or minimum base thickness).

Servicekarte

Sehr geehrter Kunde,

Sie haben sich für ein Schichtdickenmeßgerät aus dem Hause ELEKTROPHYSIK entschieden. Ihre Wahl fiel auf ein Produkt, für dessen Herstellung und Entwicklung die modernsten Technologien verwendet werden. Dennoch können einmal Funktionsstörungen auftreten. Unsere Reparatur- (Service-) ist bemüht den zeitlichen Ausfall des Gerätes für Sie während der Reparatur so kurz wie möglich zu halten.

KREUZEN SIE BITTE DEN AUFGETRETENEN FEHLER AN UND GEBEN SIE EINE KURZE BESCHREIBUNG.

Nutzen Sie den Abschnitt "Störungssuche" der Bedienungsanleitung und nennen Sie uns die Fehlermeldung. (Z.B. E05) auf der Anzeige.

Fehlerbeschreibung:

Kundenanschrift:

Kontaktperson:

- Zur Überprüfung
- Zur Reparatur
- Bedienungselemente defekt
- Meßfehler
- Anzeige defekt
- Fehlerhaftes Druckbild
- Fehler tritt zeitweilig auf
- Fehler tritt sofort auf
- Fehler tritt nach Min auf



Service CARD

Dear Customer,

You have selected an ELEKTRO-PHYSIK THICKNESS GAUGE for your quality control. Our products are based on modern technologies. An operational defect may however occur during normal use of the product. Please help our repair department to identify and solve the problem for you as quickly as possible by giving us details of the malfunction.

Please mark the error and give us a short description of the malfunction.

Use section "Trouble-shooting" of the instruction manual and indicate the error (i.e. E05) on the display.

Description of malfunction:

Address:

Please contact:

- Gage returned for Inspection only
- Gage returned for repair
- Controls defect
- Gage out of accuracy
- Display defect
- Data print out defect
- Defect occurs now and then
- Defect occurs immediately
- Defect occurs after...min. of operation

