Operating Instructions

Coating Thickness Gauges

MINITEST 1001

MINITEST 2000

E L E K T R O - P H Y S I K
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L E G E N D

1 3-digit LCD display with floating decimal point

2 Unit of measurement: µm, mm, mils, inches

3 NON-FERROUS indicates use of ferrous or non-ferrous substrate

4 ON pad to switch the gauge on. Automatic switch-off occurs approx. 90 seconds after last reading

5
1. STATS pad to display statistical values
2. STATS plus ON: switches between single and continuous measurement mode.

6
1. CLEAR pad to cancel last reading and statistics
2. CLEAR plus ON: switches between short-term and long-term mode

7
1. ARROW keys to set calibration values
2. One ARROW plus ON: displays probe identity no., software version and display test.
3. Both ARROW pads plus ON: changes basic calibration

8 Battery compartment at rear

9 1. ZERO pad for zero calibration

2. ZERO plus ON: switches between µm/mils

10 BAT : Note: change or recharge battery

11 Socket for mains adaptor

12 Probe socket

13 Type and identity no. of probe

14 Spring-loaded sleeve to hold probe

15 V-groove in the probe sleeve for rectangular positioning on convex surfaces

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O P E R A T I N G I N S T R U C T I O N S
for the coating thickness gauges with microprocessor

MINITEST 1001 and **MINITEST 2000**

These gauges work either on the magnetic induction or on the eddy current principle and conform to the industrial standards:
DIN 50981, 50982, 50984
ASTM 499, B 244
ISO 2178, 2360
BS 5411

1. Applications

The MINITEST is a compact, handy gauge for non-destructive, fast and accurate coating thickness measurement. It is suitable both for outdoor and for laboratory use.

The gauge has a range of applications, indicated by the various probes available.

F probes work on the magnetic induction principle and are designed for non-magnetic coatings such as aluminium, chrome, zinc, copper, varnish, enamel, rubber etc., on an iron or steel substrate and also alloyed and hardened magnetic steels.

N probes work on the eddy current principle and are designed to measure insulating coatings on all non-ferrous metals and on austenitic steel.

2. Description

The MINITEST 1001 model is supplied with one probe:
either probe type F1 for measurements on steel, or probe type N1 for measurements on non-ferrous metals. The measuring range of each lies between 0...1250 µm.

The MINITEST 2000 model has an additional statistics feature and is supplied with a maximum of two probes:
either with type F400 and/or F1
and/or types F1/90 or N400
and/or types N1 and/or N1/90
or with types F1 and N1
or with types F400 and N400.

There is no data print-out for the MINITEST 1001 and 2000 gauges. Our more versatile MINITEST 3001 and MINITEST 4000 gauges have an integrated interface for connection to a printer and PC. Please ask for further details.

3. Equipment

Comprising: gauge with probe(s), alkaline battery, zero plate (iron or aluminium), 2 calibration standards and instructions in several languages.

Recommended accessories
- additional probes for different uses
- convenient carrying case
- clear-view cover for dust protection

Special accessories
- mains adaptor 220V AC / 12V DC
  or 110V AC / 12V DC
- NiCd plus charger 220V AC or 110V AC
- lithium battery for approx. 30,000 measurements
- probe guide for highly accurate measurement and for measurement on small components.

4. For quick reference

For users who are already familiar with the gauge, the basic functions of the MINITEST are described in a separate quick reference guide; the guide is, however, no substitute for these complete operating instructions

5. Probes

5.1 Probe construction

The probe unit is spring-mounted in the probe sleeve. This ensures safe, stable positioning of the probe and maintains a constant probe contact pressure.
A V-groove in the sleeve of the axial probe ensures accurate measurement in the case of angled or convex surfaces. The axial probe should be held by the sleeve (see illustration).

The hemispherical probe tip is made of hard durable material (hard metal for F probes, ruby for N probes).

The gauge automatically adapts to whichever probe type is fitted. An error message (e.g. E02) will appear if the probe characteristic is not programmed into the gauge or if the probe is faulty. (see also section 23 on trouble shooting)

5.2 Probe identity numbers

Probe type	Range	Probe identity no. (series)
F400	(0... 400 µm/16 mils)	06...10
F1	(0...1250 µm/50 mils)	11...14
F1/90	(0...1250 µm/50 mils)	16...19
N400	(0... 400 µm/16 mils)	51...54
N1	(0...1250 µm/50 mils)	56...59
N1/90	(0...1250 µm/50 mils)	61...64

The probe identity number shown in brackets (see Nr.13 in the illustration) must correspond to the number in the gauge memory. Please quote this identity number when ordering replacement probes.

5.3 Displaying of attachable probes

The gauge must be switched off.
Holding down one of the ARROW keys, press ON and keep both keys depressed

for approx. 3 seconds. The probe identity numbers will now be displayed in the following order:

1. Software version e. g. 2.03
2. Identity number, 1st probe, e. g. 51
3. Identity number, 2nd probe, e. g. 56
4. etc. for further probes
5. All segments (display test)

6. Preparing for measurement

6.1 Check power supply

1. - 1x9 volt alkaline or lithium battery or
   - 1x9 volt NiCd or
   - a mains adaptor
2. Check the condition of the battery by attaching the probe and depressing ON
   - no BAT display: battery is charged
   - flashing BAT display: warning - low battery charge
   - permanent BAT display: change battery immediately
   - if the gauge switches itself off directly after being switched on, the battery is discharged and needs replacing.

A low voltage does not in any way affect the reliability of gauge readings.

6.2 Connect and screw in the probe

6.3 Switch on gauge using ON pad. Hold the probe in the air at the same time.

- The last measured value, if available, will now appear.

- Readings can be taken immediately if the gauge has already been calibrated.

- The gauge will switch off automatically about 90 seconds after the last reading.

- The gauge also switches itself off if the probe is disconnected.

- The last reading, the calibration values and any current statistics remain in memory. If the power supply is interrupted, as in the case of a battery change, these values will be erased.

7. General remarks on calibration

1. Calibration sample

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

   Example:

If a coating is to be measured on a mild steel cylinder, diameter 6 mm / 1/4 inch, the calibration must take place on an uncoated steel cylinder of identical quality with an identical diameter.

The calibration sample must correspond to the product sample as follows:

- in the curvature radius of the surface
- in the characteristics of the substrate
- in the thickness of the substrate (if thinner than 1 mm / 40 mils.)
- in the size of the area to be measured (for small components)

2. Effects of the substrate thickness

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

- In the case of non-ferrous metals, it is sufficient if the substrate is 50 µm/ 2 mils thick, on condition that it is firm enough not to give way under the pressure of the probe tip; e. g. a thin coating on an aluminium foil can be measured if stuck on a hard base.

- The enclosed iron and aluminium zero plate are for test purposes only and are not generally recommended for calibration.

Exceptions:
A zero plate may be used for calibration if the product sample has a smooth even texture (not shot-blasted) and

a. with steel components thicker than 1mm/40 mils; in this case, the enclosed iron zero plate may be used for calibration by placing it on the coated sample.

b. with aluminium components thicker than 50 µm/2 mils. In this case the enclosed aluminium zero plate may be used for

calibration. Thin aluminium foils must be stuck on to a firm substrate.

3. High-precision calibration

   To achieve high-precision readings, it is advisable to set zero several times in succession.
   The gauge will automatically establish an average zero.

4. Cleaning the measuring point

   Before calibration the measuring point and the probe tip must be free from grease, oil, scraps of metal, etc. The slightest impurity affects measurement and distorts readings.

5. Bleep signal

   Whether the probe is being used for calibration or for measurement, it must be held in place until the bleep sounds, it can then be lifted off.

6. Temperature compensation feature

   No recalibration is necessary in variable temperature conditions as the gauge will automatically take these into account (see technical data).

8. General remarks on measurement

If calibration has been carried out correctly, all associated readings will

remain within the guaranteed tolerance limits (see technical data).

From a statistical point of view, **one** reading is **no** reading. For this reason, any reading displayed by the MINITEST is in fact the average of five "invisible" readings. When the probe is applied, these five readings are evaluated in a fraction of a second and displayed as a mean value.

With the statistical program of the MINITEST 2000, the mean calibration value may be more accurately estimated if the probe is activated several times at a significant measuring point. Any freak values can be erased straightaway with the CLEAR pad. With pipe probes, however, the last reading (possibly a freak reading) cannot be erased (see section 10).

The final reading is a result of
1. the statistical calculations and
2. the guaranteed tolerance limits of the gauge.

Example:

TH (coating thickness) = X + s + t

X = mean value =. 153 µm /6.0 mils
s = standard tolerance = ±3 µm /0.12 mils
t = gauge tolerance range,
e.g. ± (1% of reading + 1µm/0.04 mils)

= ± (1.5 µm + 1µm) = 2,5 µm or
= ± (0.06 mils + 0.04 mils) = 0.1 mils

TH = 153 µm ± 5.5 µm or
TH = 6.0 mils ± 0.22 mils

9. Calibration and measurement using probe types F400, F1, N400, N1

1. Place probe on an uncoated sample (zero coating thickness) and remove after the bleep.

2. Press ZERO pad.
   The display will show 0.0.

2.1. If the mean value is to be made up of a number of zero values, repeat steps 9.1 and 9.2 several times.

2.2. To delete the average zero (e.g. if an incorrect zero value has been entered):
place the probe on the zero plate or the product sample at least once without pressing the ZERO pad.
Now start taking a new set of zero values to obtain an average zero.

This deletes the previous setting and logs the new one.

3. Place the calibration foil on the uncoated product sample, position the probe and remove it after the bleep has sounded;

The foil thickness should be reasonably close to the assumed coating thickness.

4. Adjust to the foil thickness (CAL) by using the ARROW pads.

5. Now measure: place the probe on the unknown coating, remove after the bleep and take a reading.

Please note:
The ARROW pads can be depressed each time, but may also be held down as a useful aid to fast setting.

10. Calibration and measurement using pipe probes F1/90 and N1/90 (applies only to MINITEST 2000)

When pipe probes are attached, the gauge switches automatically to continuous measurement mode.

1. Calibration and measurement are as described in section 9.
2. The average-zero-setting is not possible.
3. The last reading can only be entered into the statistics memory by pressing the STATS pad while applying the probe.
4. To display the statistics, press the STATS pad while the probe is lifted.
5. To delete the statistics, keep the probe lifted and press the CLEAR pad twice.

6. The last reading (which may be a freak value) cannot be erased in continuous mode.

11. Calibration and measurement on blasted steel surfaces

The physical nature of blasted surfaces results in readings that are too high. The mean thickness over the peaks can be determined as follows (using the statistics program speeds up operations):

1. The gauge should be calibrated according to the method described in section 9. Use a smooth surface.

2. For the MINITEST 2000, delete the statistics by depressing CLEAR twice.

3. Now take approx. 1O readings on the uncoated, shot-blasted surface to calculate the mean value. With the MINITEST 2000, it can be displayed by using the STATS pad. This mean value should be termed Xo.

4. For the MINITEST 2000, delete the statistics once more by depressing CLEAR twice.

5. After this take approx. 1O readings on the coated and similarly blasted sample to produce a mean value. With the MINITEST 2000, this can be displayed by using the STATS pad. This value should be termed Xm.

6. The difference (Xm - Xo) is the mean coating thickness over the peaks. For coating thicknesses over 3OO µm/ 12 mils, the degree of surface roughness is of such minimal significance for the readings that the above methods can be dispensed with. For calibration purposes, however, the rough surface should be smoothed over with, for instance, emery cloth.

12. Calibration and measurement of chrome coating on copper with probe types N400, N1 or N1/90 using a special foil

Use only the special measuring foil marked "chrome on copper". Do not employ any other kind of foil.

13. Determining the test result

The test result should be evaluated from at least 3 readings. The mean value is then the most likely. (See also section 8, General remarks on measurement)

14. Adjusting the basic calibration

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

- if the probe tips are worn
- if replacement probes have to be fitted
- for special applications

(if necessary consult the manufacturer)

If in the course of comparative measurements with precision standards it becomes evident that the permitted tolerances are greatly exceeded, the probe characteristic can be reset. Recalibrate by entering 6 calibration values (1 zero and 5 thickness readings).

1. The gauge should be switched off; e.g. by briefly disconnecting the probe. Holding down both ARROW pads, press ON (correction mode).

Please note:
There will now be a short bleep followed by a long one. No reading will be displayed. After each measurement and after a pad has been pressed a long signal will be heard instead of the usual short bleep. This confirms that the gauge is in basic calibration mode.

2. The first calibration value (zero) results from setting zero. Repeating this (setting a mean value) will result in an even higher degree of accuracy. The procedure is described in sections 9.1 - 9.2.1 above.

3. Set the second and all subsequent calibration values, by using calibration foils in ascending order of thickness. The method is virtually that described in sections 9.3 and 9.4. Repeat 9.3 and

9.4 several times in quick succession to set a mean calibration value. This also ensures an increased degree of accuracy.

Important:
Even if the resulting value should be identical to that of the foil, it is still necessary to press the arrow pads e.g. once up and once down.

The thickness of each subsequent measuring foil should differ from the last by a factor of at least 1.6; ideally it should be double the last one, e.g. 5O, 1OO, 2OO, etc.

After the 6 calibration values have been entered, an arbitrary reading must be taken in order to switch the gauge off. When the gauge is switched on again, the new calibration values will be in force.

The basic calibration procedure can be terminated simply by detaching the probe. The values already entered will not be stored.

The manufacturers supply a set of 5 correction foils optimized for the MINITEST measuring range.

15. Statistics program - MINITEST 2000

The statistics program automatically produces 5 statistical values from a maximum of 255 single readings.

15.1 Input of single values for statistical evaluation

1. Before starting a new series of measurements, the previous statistical values must be deleted: press the CLEAR pad twice.

2. Readings may now be taken. The readings displayed will automatically be entered into the statistics program.

To continue a series of measurements after the gauge switched itself off, simply press ON pad. Do not delete the values allready entered, they will be taken into account in the final statistical evaluation.

15.2 Displaying the 5 statistical values

The statistical values may be reviewed at any time.

Each time the STATS pad is depressed, the following numbered data will be displayed in this order:

1. Mean value
2. Standard deviation
3. Number of measurements.
4. Highest reading
5. Lowest reading

15.3 Deleting a false or freak reading
(not applicable to pipe probes)

1. The gauge should be switched on.
2. Press CLEAR once.
   The last freak reading will be cancelled, and the last reading (if available) displayed.
   Deletion must take place immediately after the faulty measurement and before the next measurement.

15.4 Deleting all statistics

To delete all current statistics, any one of the following three methods may be used.

1. The gauge should be switched on and the probe attached.
   Press CLEAR twice.
   Only the unit of measurement will remain on the display, e.g. µm/mils.

2. The power can be cut off for at least 3 seconds, by, for instance, changing the battery. All statistics (and also the calibration values) will then be automatically deleted.

3. If the probe is changed to begin a new series of measurements, the statistical values are automatically deleted when the gauge is switched on again.

Please note:

- Calibration does not in itself cancel the current statistics. Readings taken before calibration will be combined with those taken afterwards; both sets will be logged in the statistics program.

- Calibration values cannot be entered into the statistics memory.

- The calibration values are easily distinguishable from measuring values; calibration values can only be entered by pressing one of the calibration pads ZERO or CAL.

15.5 Storage capacity overflow

If more than 255 values are entered, the 5 statistical values cannot be updated, though measurement can continue.

16. Switching between single measurement and continuous measurement mode

- applicable only to MINITEST 2000 -
(N.B. Pipe probes can only function in continuous mode)

For special applications it may be usefull to display continuous readings without lifting the probe between single measurements.

1. The gauge is switched off:
   e.g. by briefly disconnecting the probe.

2. Holding down STATS, press ON and keep both pads depressed for about 3 seconds until the bleep sounds.

3. Readings will now flash on the display, but will not be accompanied by a bleep.

4. All readings taken in this mode (max. 255) will automatically be entered into the statistics program of the MINITEST 2000 for later evaluation.

5. Return to standard mode by repeating steps 1 and 2.

Please note:
Continuous mode cannot be used to set zero (see section 9.2.1).

17. Switching between short-term and long-term modes

The gauge is designed to switch itself off after about 90 secs. Under certain conditions this can hinder operations; in this case transfer to the alternative long-term mode.

1. The gauge should be switched off;
   e.g. by briefly disconnecting the probe.

2. Holding down CLEAR, press ON and keep both pads depressed for about 3 seconds until the bleep sounds. The gauge is now in long term mode.

   The gauge can be switched off by disconnecting the probe. Long-term mode will be retained even when the gauge is switched on again.

3. Return to standard (short-term) mode by repeating steps 1 and 2.

18. Switching between µm and mils

To switch between the metric system (µm, mm., cm.,) and the Imperial system (mils, inches), proceed as follows:

1. The gauge is switched off; e.g. by briefly disconnecting the probe.

2. Holding down the ZERO pad, press ON and keep both pads depressed for about 3 seconds until the bleep sounds.

   The new unit of measurement will be retained even if the gauge is switched off and on again.

3. Return to metric units by repeating steps 1 and 2.

19. Useful accessories

- See section 3 for optional extras.
- We also supply wet film gauges (using the comb principle) which measure wet coatings on freshly-painted surfaces. Measuring range; 25 µm - 800 µm / 1 mil - 32 mils.

20. Maintenance

The MINITEST needs an occasional battery change but is otherwise maintenance-free. It is extremely robust, but, as with any measuring instrument, it should be handled with care.

Used batteries must be removed from the gauge without delay.

21. Customer service

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

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

22. Additional gauges and detectors

We manufacture a whole range of gauges for measuring:

- non-magnetic coatings and nickel coatings on steel, using the magnetic attraction principle (MIKROTEST type)

- galvanised coatings on all substrates using the coulometric principle (GALVANOTEST type)

- non-magnetic foils, sheetings or coatings, using the continuous magnetic induction principle (ELEKTROTEST KDM uP type)

We also supply pore detection units for:

- insulating coatings on all metals (POROTEST type)

- insulating coatings on concrete (POROTEST type)

23. Trouble-shooting

The following list of error messages explains how to identify and eliminate faults.

EO1 Probe type incompatible with gauge
EO2 Probe faulty or not properly connected
EO3 Probe faulty
* probe needs repairing
EO4 Probe (or gauge) is giving unreliable readings (e.g. as a result of strong fluctuations in the magnetic field or readings taken on soft coatings)
EO5 Probe was held too near to metal when switched on
EO6 Battery voltage too low
* insert new battery
EO7 Gauge defective
* gauge and probe need repairing

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EO8  Probe defective
     * gauge and probe need repairing
EO9  Software version incompatible with gauge
E10  Software version incompatible with probe
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EO1 ... E1O: Gauge switches off after message

E15 ZERO function not possible
* the value of the reading is too high
to set zero
restart zero setting

If faults occur without an error message
appearing, e.g.:
- the gauge fails to switch itself off
- readings are no longer registered
- the pads do not work
- the readings are inconsistent

then the quickest remedy is a total reset.
Cut off the power supply for approx.
3 seconds and restart.