Bedienungsanleitung

Schichtdickenmeßgerät
Datendrucker

MiniTest 1100 - 2100
MiniPrint 4100

Operating Instructions

Coating Thickness Gauge
Data Printer

ElektroPhysik

Meßsysteme für Oberflächentechnik Surface Testing Instruments


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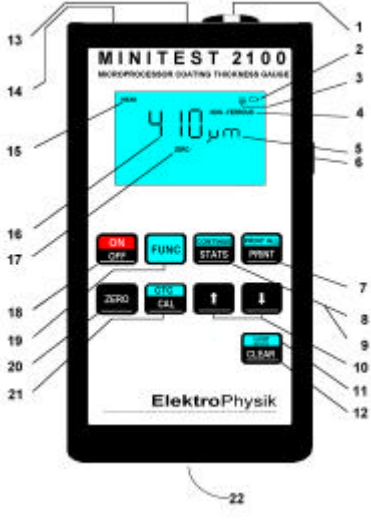
MINITEST 2100
MICROPROCESSOR COATING THICKNESS GAUGE
410µm
ON
OFF
FUNC
STATS
PRINT
ZERO
CAL
CLEAR
ElektroPhysik
1
2
3
4
5
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7
8
9
10
11
12
13
14
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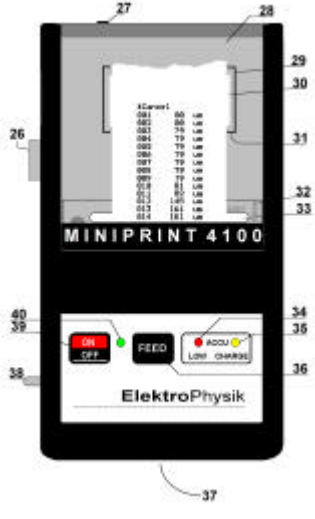
MINIPRINT 4100
ON
OFF
FEED
ACCU
LOW
CHARGE
ElektroPhysik
26
27
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31
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33
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Tabelle der Initialfunktionen

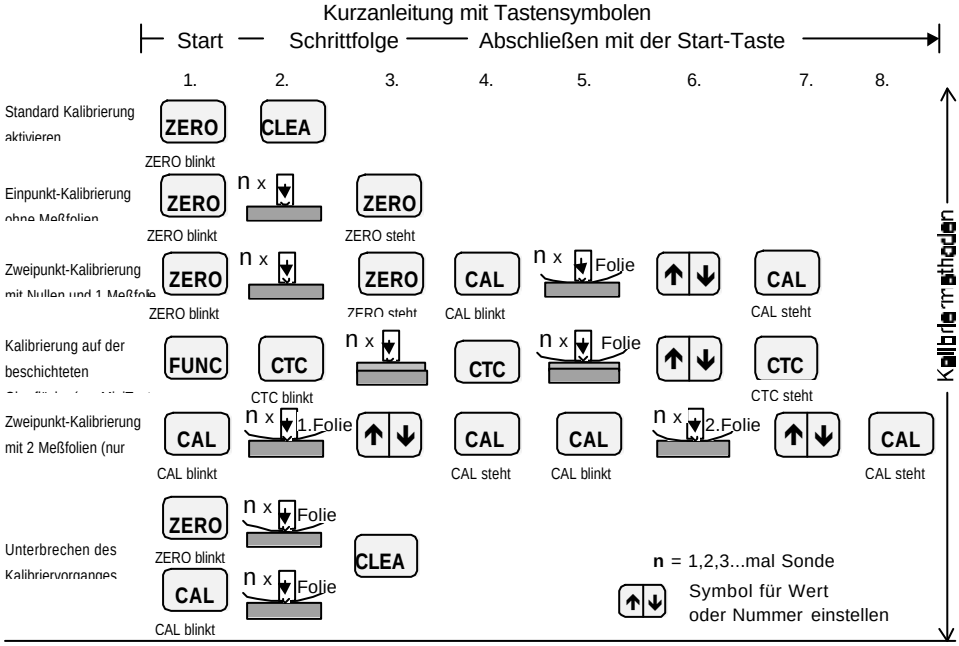
Funktion	**Tastendrücke**
Total-Reset	FUNC+CLEAR+ON
LCD-Test	⇧-Taste + ON
Zeit-Einstellung [1]	CAL + ON
Grundeinstellungen	FUNC + ON

[1] nur MiniTest 2100

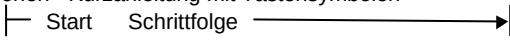
Tabelle der Grundeinstellungen

FUNC		**Modi-Einstellung**	
1	0	Maßeinheit	Metrisch / mm
	1		Imperial / inch
2	0	Ausschaltmodus	Kurzzeitbetrieb
	1		Dauerbetrieb
3	0	Datenformat	Fließkomma
	1		Fixkomma
4	0	Statistik	Einzelwertstatistik
	1		Blockwertstatistik
5	0	Aufnahme in	Tastendruck
	1	Statistik *	Kontinuierlich
6	0	Warten auf	Stabiler Meßwert
	1	stabilen Meßwert*	Jeder Meßwert
7	0	Keylockfunktion	Aus
	1	für ZERO, CAL, CTC, Offset	Keylock (Tasten-verriegelung)
8	0	Beleuchtung der	nicht aktiv
	1	Anzeige (Option)	aktiv
9	0	Speichern des *	nicht aktiv
	1	kleinsten Meßwertes	aktiv
10	0	keine Funktion bei	
	1	MiniTest 1100/2100	

[1] nur MiniTest 2100, [2] im kontinuierlichen Modus


Kurzanleitung mit Tastensymbolen
Start
Schrittfolge
Abschließen mit der Start-Taste
1.
2.
3.
4.
5.
6.
7.
8.
Kalibriermethoden
Standard Kalibrierung aktivieren
ZERO
CLEA
ZERO blinkt
Einpunkt-Kalibrierung ohne Meßfolien
ZERO
n x
ZERO
ZERO blinkt
ZERO steht
Zweipunkt-Kalibrierung mit Nullen und 1 Meßfolie
ZERO
n x
ZERO
CAL
n x
Folie
CAL
ZERO blinkt
ZERO steht
CAL blinkt
CAL steht
Kalibrierung auf der beschichteten
FUNC
CTC
n x
CTC
n x
Folie
CTC
CTC blinkt
CTC steht
Zweipunkt-Kalibrierung mit 2 Meßfolien (nur
CAL
n x
1.Folie
CAL
CAL
n x
2.Folie
CAL
CAL blinkt
CAL steht
CAL blinkt
CAL steht
Unterbrechen des Kalibriervorganges
ZERO
n x
Folie
CLEA
ZERO blinkt
CAL
n x
Folie
CAL blinkt
n = 1,2,3...mal Sonde
Symbol für Wert oder Nummer einstellen

Löschfunktionen - Kurzanleitung mit Tastensymbolen



Löschen des letzten Meßwertes

Löschen der Statistikwerte
(nur MiniTest 2100)

Löschen aller Meßreihen inklusive
ihrer Statistik-, Grenz-, und Eichwerte
in allen APPL-BATCH-Speichern
(TOTAL-Löschung)

{ Tasten nacheinander drücken und alle gedrückt halten

Symbol für Wert
oder Nummer einstellen

L E G E N D E

1 Sondenbuchse

2 BAT: Hinweis für Batteriewechsel oder Akku-Ladung

3 Hinweis: Gerät wird vom PC angesteuert. Tastatur ist blockiert

4 NON-FERROUS, Betriebshinweis für Messung auf Eisen (FERROUS) oder Nicht-Eisen (NON-FERROUS).

5 Maßeinheit schaltet sich abhängig von Sonde und Meßwert automatisch um: µm, mm oder mils, inch

6 Kombischnittstelle für MiniPrint, Mitutoyo-Auswertegeräte, PC...

7 Taste zum Ausdruck der Meßwerte, Statistikwerte

8 Umschalttaste für kontinuierliche Messung

9 Taste zum Abruf der Statistikwerte

10 Pfeil-Tasten für alle Einstellungen (z.B. Kalibrierwerte)

11 Löschtaste für die Statistik (MiniTest2100)
1. Umschalttaste für kontinuierliche Messung (MiniTest 1100)

12 Löschtaste

13 Buchse (Option)
1. externe Triggermöglichkeit z.B. mit Fußschalter (Meßwert übernehmen)
2. Meßwert-Bestätigungssignal z.B.: für Lampe oder Hupe

14 Buchse für Steckernetzteil

15 Hinweis: Ziffernanzeige ist ein Statistikwert. Hier: Mittelwert

16 4stelliges LC-Display mit Fließkomma

17 Hinweis für Nullung

18 Taste zum Ein- und Ausschalten des Gerätes

19 Funktionstaste aktiviert die oberen blauen Tastenbefehle

20 Taste zum "Nullen" des Gerätes ohne Kalibrierstandards

21 Taste zum Kalibrieren mit Standards

22 Batteriefach auf der Rückseite

23 Federnde Griffhülse zum Halten der Sonde

24 V-Nut in der Griffhülse zum sicheren Aufsetzen auf gekrümmten Oberflächen

25 Meßgegenstand

26 Schnittstelle für MiniTest

27 Buchse für Ladegerät

28 Plexiglasabdeckung

29 Wanne für Papierrolle

30 Papierrolle

31 Batteriefach unterhalb der Papierrollenwanne

32 Farbband

33 Austrittsöffnung für Papiervorschub

34 LED-Anzeige (rot) Ladezustandskontrolle der NiCd-Akku's

35 LED-Anzeige (gelb) Ladekontrolle

36 FEED-Taste für Papiervorschub

37 Batteriefach auf der Rückseite

38 Führungsstift

39 ON / OFF-Taste zum Einschalten / Ausschalten der Druckbereitschaft

40 LED-Anzeige (grün) Druckbereitschaft MiniPrint 4100

Table of basic settings

Function	Key combination
Total reset	FUNC+CLEAR+ON
LCD test	⇧-key + ON
Adjust time [1]	CAL + ON
Set gauge options	FUNC + ON

[1] MiniTest 2100 only

Table of start-up functions:

FUNC		Modi-setting	
1	0	Measuring mode	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
4	0	Statistics	single value statistics
	1		block-value statistics
5	0	Input to	manual
	1	statistics*	automatic
6	0	Await stable	stable reading
	1	reading *	every reading
7	0	Key lock function	Off
	1	for ZERO, CAL, CTC, offset	Keylock
8	0	Display light	inactive
	1	(Option)	active
9	0	Saving the *	inactive
	1	minimum value	aktive
10	0	not for	
	1	MiniTest 1100/2100	

* in continuous mode for MiniTest 2100 only,

‘Delete’ functions - Short instructions with key symbols

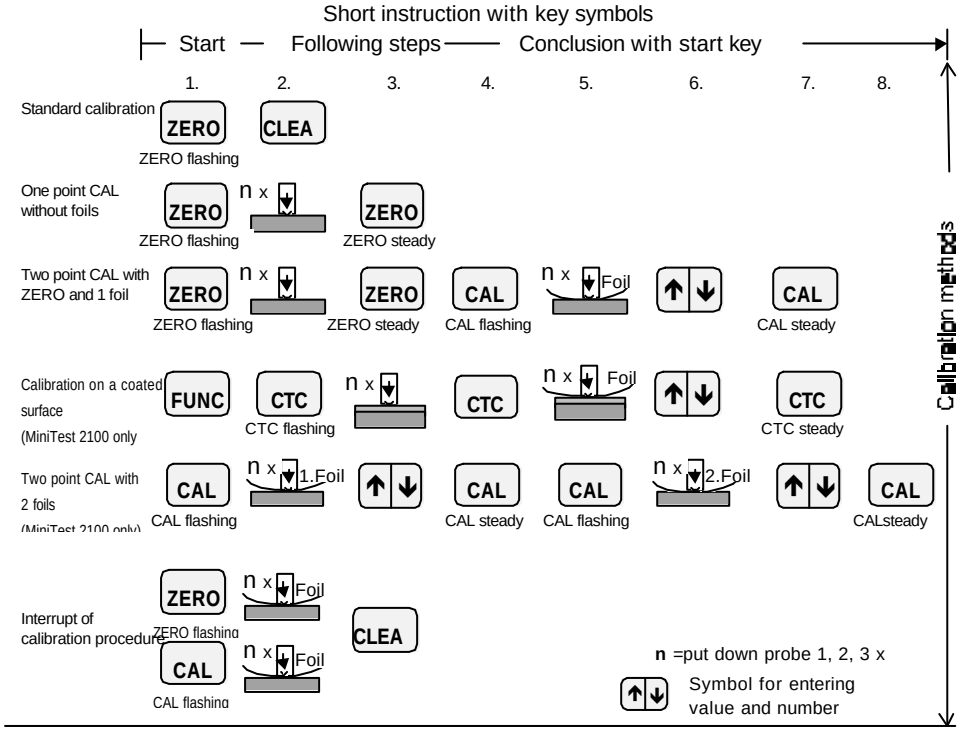
Deleting the last reading taken

Deleting statistics
(MiniTest2100 only)

Deleting all series of measure-ments including associated statistics and calibration data
(delete all)

{ Press these keys one after the other and hold all three down.

Symbol for entering value and number


Short instruction with key symbols
Start
Following steps
Conclusion with start key
1.
2.
3.
4.
5.
6.
7.
8.
Standard calibration
ZERO
CLEA
ZERO flashing
One point CAL without foils
n x
ZERO
ZERO flashing
ZERO
ZERO steady
Two point CAL with ZERO and 1 foil
n x
ZERO
ZERO flashing
ZERO
ZERO steady
CAL
CAL flashing
n x
Foil
CAL
CAL steady
Calibration on a coated surface
(MiniTest 2100 only
FUNC
CTC
CTC flashing
n x
CTC
n x
Foil
CTC
CTC steady
Two point CAL with 2 foils
(MiniTest 2100 only)
CAL
CAL flashing
n x
1.Foil
CAL
CAL steady
CAL
CAL flashing
n x
2.Foil
CAL
CALsteady
Interrupt of calibration procedure
ZERO
ZERO flashing
n x
Foil
CAL
CAL flashing
n x
Foil
CLEA
n =put down probe 1, 2, 3 x
Symbol for entering value and number
Calibration methods

Contents

OPERATING INSTRUCTIONS

Coating thickness gauges

MiniTest 1100 and MiniTest 2100

and

MiniPrint 4100 data printer

The MiniTest 1100 and 2100 coating thickness gauges work either on the magnetic induction principle or on the eddy current principle, depending on the type of probe used.

The gauges conform to the following industrial standards:

DIN 50981, 50982, 50984, ASTM B499, B244, ISO 2178, 2360, BS 5411

DIN 50981 and 50984 have been replaced by the standards 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 their 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 all readings and statistical values, either immediately or for later analysis.

The MiniTest 1100 allows only immediate print-out of 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; they are also suitable for alloyed and hardened magnetic steel.

N probes work on the eddy current principle and should be used for insulating coatings on all non-ferrous metals and on austenitic stainless steels.

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 / 2100 'smart' probes are adaptable as regards specialised tasks; i.e. they can be used on geometrical structures 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 / 2100 gauges work on the magnetic induction principle: for measurements on non-ferrous substrates they work on 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.

1.2.1 MiniTest 1100

The gauge allows user-friendly operation, measuring data are neither stored nor edited statistically.

In connection with the portable data printer MiniPrint 4100, all measuring data can be printed immediately.

1.2.2 MiniTest 2100

The MiniTest 2100 user-friendly measuring system permits automatic storage of up to 10 000 readings in one memory matrix for use in print-outs and/or for later statistical evaluation.

1.3 Equipment

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

Optional extras:

- Special-purpose probes

- MiniPrint 4100, 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 logging of MiniTest readings. Available for IBM and IBM-compatible PCs
- Program disk "MSOFT41" for WINDOWS 3.1x® or WINDOWS 95®, to process MiniTest data and statistical values (MiniTest 2100 only)
- 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 230V AC/12V DC
- mains adapter 110V AC/12V DC
- accumulator battery and charger, 230V 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-probe and special models) are spring-mounted in the probe sleeve. This ensures safe 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 and MiniTest 2100 gauges.

Probes are identified by,

a) the colour of the protective cover:
   Black = F probes
   Red = N probes
   Green = FN probes
b) the type description and
c) an identity number

e. g. F3 (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 1100/2100 gauges 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.	
F 06	(0...600 µm)	A0	
F 1.6	(0...1600µm)	A1	
F 3	(0...3000µm)	A1	
F 1.6/90	(0...1600µm)	A4	
F 2/90	(0...2000µm)	A4	metals
F 10	(0...10 mm)	A6	
F 20	(0...20 mm)	A8	
F 50	(0...50 mm)	AA	
FN 1.6	(0...1600µm)	80	ferrous and
FN 2	(0...2000µm)	80	non-ferrous metals
N 02	(0..200 µm)	A2	
N 1.6	(0..1600 µm)	A3	
N 2	(0..2000 µm)	A3	
N 1.6/90	(0..1600 µm)	A5	non-ferrous
N 2/90	(0..2000 µm)	A5	metals
N 10	(0.....10 mm)	A7	

N 20	(0.....20 mm)	A9
N 100	(0...100	B1
CN02	(10..200 µm)	B4

2. Preparing the MiniTest 1100 and 2100 gauges

2.1. Checking the current supply

1. 1 x 9 volt alkaline-battery or
   1 x 9 volt rechargeable battery 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 permanent BAT warning and the gauge will switch itself off after about a second.

Note that the gauge will <u>not</u> 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 compartment.
4. Remove battery.
5. Insert new battery.
   <u>Caution:</u>
   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, time and date (MiniTest 2100 only).

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 and 2100 gauges include 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
Adjust time [1]	CAL + ON
Set gauge options [2]	FUNC + ON

[1]MiniTest 2100 only [2]page 64

2.4.1 Total reset

A total reset erases data from all memories. This includes all sets of readings plus their associated statistics and calibration values. Total reset erases temporary settings and the gauge will resume the basic MODI-setting (FUNC - : / **0**, see section 2.5, table on p. 64).

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 if necessary.
2. Hold down the ⇧ - 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.

2.4.3 View/adjust time and date (MiniTest 2100 only)

The gauge has a quartz-controlled timer which relays information to the MiniPrint 4100. The current date and time appear automatically on each print out of statistics.

To view and if necessary adjust the time and date:

1. Switch off the MiniTest gauge.
2. Hold down the CAL key and press ON. Keep both keys depressed until you hear the bleep.

2a. If an FN1.6 or FN2 probe is attached, press one of the arrow keys.

3. A flashing “TIME“ signal will appear on the display with a preset year: e.g. Y (= Year).
4. Adjust to the correct year with the arrow keys.
5. Press CAL.

   The month will now appear, e.g. <3M>

6. Adjust to the correct month with the arrow keys.
7. Press CAL.

   The day of the month will now appear, e.g. <3d>.

8. Adjust to the correct day with the arrow keys.
9. Press CAL.

   The hour will now appear e.g. <3h>.

10. Adjust to the correct hour with the arrow keys.
11. Press CAL.

    The minutes will now appear, e.g. <3m>.

12. Adjust to the correct minutes with the arrow keys.
13. To save the new date and time , press CAL again. The seconds are reset to 0. The gauge will return automatically to measuring mode.

Note:
When you view the time and date, please remember that the clock stops for as long as it is on display. If the timer does not need adjusting, keep pressing CLEAR until the gauge returns to measuring mode.

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 using an FN1.6 or FN2 probe, use the arrow keys to activate the F section (⇧) or the N section (⇩).
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 or 1.
4. Press FUNC again to return to measuring mode.

Table of basic settings

FUNC		Modi-setting	
1	0	Measuring mode	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
4	0	Statistics	single value statistics
	1		block-value statistics
5	0	Input to statistics*	manual
	1		automatic
6	0	Await stable reading *	stable reading
	1		every reading
7	0	Key lock function for ZERO, CAL, CTC, offset	Off
	1		Keylock
8	0	Display light (Option)	inactive
	1		active
9	0	Saving the * minimum value	inactive
	1		aktive
10	0	not for MiniTest 1100/2100	
	1		

* MiniTest 2100 only, in continuous mode

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

To switch from metric units (µm, mm, cm) to Imperials (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 will now return to the measuring mode. The series of measurements can be continued with the new measuring unit. Previous readings in the series will be converted to the new unit automatically (MiniTest2100 only).

2.5.2 Switching between short-term and long-term modes

The gauge is programmed to switch itself off after about 90 seconds of inactivity. 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 Switching between single-value and block-value statistics (MiniTest2100 only)

The statistical values can be calculated on the basis of either individual values or blocks of values before being transferred to a printer or PC.

Block value statistics are calculated from a block of mean values. First an average is taken from a user-defined block of readings. Then a mean value is derived from a series of these averages and used for statistical analysis: The number of

readings assigned to each block can be altered via a PC. Default = 5 readings

To select the single-value or block-value option, please refer to the table of gauge settings on section 2.5. Select an option with the FUNC and arrow keys as described.

2.5.5 Switching between manual and continuous measurement mode: Transfer of readings to statistics memory (MiniTest2100 only) or data transfer to a printer or PC
0: manual transfer with ⇧-key
1: automatic transfer

The continuous mode allows automatic transfer of readings to statistics memory (only MiniTest 2100) or to a printer or PC. If only selected readings are to be logged to memory, choose manual measurement mode and enter the readings either via the keyboard (⇧-key) or by a foot-operated switch (optional extra). (See also section 2.5.9)

In automatic mode readings can be entered at a rate of approx. 5 per second.

To switch between automatic and manual mode, 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 Display of readings and transfer of readings to statistics memory, printer or PC only after stabilising measurement in continuous mode.

In the standard gauge setting, readings are not displayed until the signal stabilises within a given range (data filter).

In continuous measuring mode, however, this stabilising procedure can be deactivated, e.g. for easier verification of minimum and maximum thickness values. (See also sections 4.2.8 and 4.2.14).

Only MiniTest 2100 allows transfer of readings to statistics memory.

To switch the stabilising procedure on or off, please refer to the table of gauge settings in section 2.5. Select option with the FUNC and arrow keys as described.

2.5.7 KEYLOCK Function for ZERO-, CAL- and CTC- (MiniTest2100 only) keys. (Locks calibration keys)

An accidental recalibration 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.

2.5.8 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 secs 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.

2.5.9 Saving the minimum measuring value in continuous mode

This function allows to determine the minimum value within a continuous measuring procedure in continuous mode. When measuring, the current measuring value is displayed. After lifting the probe from the surface the minimal measuring value (minimum value of a measuring series) is displayed for 5 seconds. During this time the minimum value can be transferred to the statistics via the UP arrow key (⇧) or a foot-operated switch (optional extra).

The minimum value is deleted after being transferred to the statistics or after being displayed for 5 seconds. When further measurements are taken within this 5 seconds the existing minimum value is saved. This procedure allows to view the minimum value for a short time while taking a continuous measurement.

The minimum value mode is set by FUNC- and arrow-key as described in 2.5 and in the table of basic settings.

2.5.10 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. A short bleep confirms the change of mode.
3. When the measuring unit (µm, mils) flashes it means that the continuous mode is in use. Measurements outside the measuring range will be indicated by four lines (**- - - -**). Continuous measurement mode, readings are not accompanied by a bleep and the optional display lamp is deactivated.
4. To log readings to the statistics memory (MiniTest2100 only) or to print-out readings on a printer, or to transfer readings to a PC via the interface, press the arrow key (⇧) or push the foot-operated switch (optional extra).
5. For continuous input of all readings, follow the procedure described in section 2.5.5. Readings taken in this mode will automatically be entered into the statistics program as long as sufficient memory is available.
6. 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 does not apply to probes F2/90, N2/90 or N100,).

3. Calibration and measurement

3.1 General remarks on calibration

3.1.1 Methods of calibration

Five different calibration methods are available for the MiniTest 1100 / 2100 gauges:

- Standard calibration
  recommended for even surfaces and for approximate measurements, i.e. those that do no not require the degree of accuracy of one-point calibration.
- One-point calibration:
  set zero without foil
  recommended when measuring errors up to 3% are permitted. The standard deviation of the probe should also be taken into account.
- Two-point calibration:
  set zero and calibrate with one foil
  recommended when measuring errors of between 1% and 3% (maximum) of the measured value are permitted. The given error range of the probe should also be taken into account.
- Two-point calibration (MiniTest2100 only):
  set zero and calibrate with two foils:
  recommended when:
  a) taking readings on rough surfaces.
  b) exact measurements are required on smooth surfaces whose thickness lies between that of the two calibration foils.
- Calibration through an unknown coating thickness (MiniTest2100 only):
  calibrate using foil (applies only to F 06, F 1.6, F 3, FN 1.6 & FN2 (F-part), F 1.6/90, F2/90, F 10, F 20 and F 50 probes).
  Recommended when the test sample is coated and no uncoated sample is available for comparison.

Note:
the term calibration foil applies to all calibration standards, including those not normally described as 'foil': e.g. those with thickness of 2mm, 5mm and 10mm.

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 4.1.8, 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:
If during the calibration procedure:

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

calibration cannot be continued. 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 a product is to be measured on a steel cylinder, quality ST37 (mild steel), ø 6 mm, the calibration of an uncoated sample must take place on a steel cylinder of similar quality 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

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 substrates, 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 thick and strong enough not 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.
- if aluminium parts are thicker than 40 microns. In this case the enclosed aluminium plate 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, etc. 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 3.2.13, the basic procedure is always as follows:

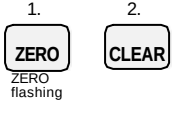
1. Start calibration by pressing the appropriate calibration key (ZERO or CAL or CTC).
2. Apply the probe to the test sample.
3. End calibration by pressing the calibration key again (ZERO or CAL or CTC).

   (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.

The probe must be at a distance of at least 50mm (2") from metal components.



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.

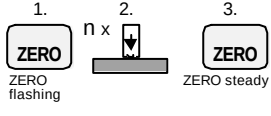
a) on steel components made of conventional construction steel (mild steel).

b) on aluminium components.

Note:
It is important to record a sufficient number of exact zero readings on an uncoated sample. If not, one-point or two-point calibration should be used.

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 (steady). 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 (steady)

4. Now take readings by placing the probe on the unknown coating 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.

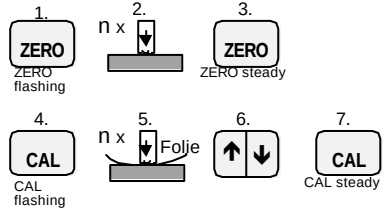
b) or restart ZERO calibration by repeating steps 1 to 3 above. This automatically deletes the old calibration and saves the new calibration

   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 (steady). MEAN indicates that the mean value of the readings will be 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 (steady) will appear on the LC display

4. Press CAL to initialise foil calibration.

   The display will show CAL (flashing) and MEAN (steady). MEAN indicates that the mean value of the readings will be 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 (steady).

8. Now take readings by placing the probe on the unknown coating 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 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.

Note:
Even while a series of measurements is being taken, foil calibration can be carried out as often as necessary. The old calibration will be overwritten; the ZERO calibration remains in memory.

Special remarks for probe types F10, F20 and F50: 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 actual coating..

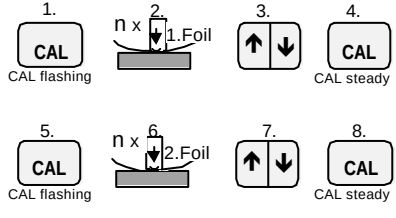
3.2.4 Two-point calibration (with two foils) (MiniTest2100 only

Applicable to all probes (except CN02)

Calibration is only possible in single measurement mode. If necessary switch to the mode as in section 2.5.9.

This method requires the use of two foils of varying thickness. The foils should differ in thickness by at least a factor of two. For best results, the estimated thickness of actual coating should lie somewhere between the two calibration values.

This method is especially suitable for taking measurements on rough shot-blasted surfaces or for high-precision readings. It is advisable to take a mean of CAL values. This considerably reduces the effect of the scattering which occurs during calibration of upper and lower values.



1. First press ZERO, then place the probe on the uncoated sample and press ZERO again. (Although not an integral part of procedure, this produces a rough approximation of the final setting.)

   The calibration foils may be used in any order.

2. Press CAL to initialise calibration.

   THE LC display will show CAL (flashing) and MEAN (steady). MEAN indicates that the mean value of the readings will be shown on the display.

3. Place the thinner of the two foils (e.g. approx. 10...30µm) on the uncoated test sample, apply the probe and raise it after the bleep.

   Apply the probe to the uncoated test sample several times. The display always shows the mean value of the previous readings.

   To discontinue calibration, press CLEAR.

4. Adjust to the thickness of the foil with the arrow keys.

5. Press CAL. CAL (steady) will appear on the LC display.

6. Press CAL to initialise calibration. This step must follow straight on from step 5. The gauge will not accept readings until CAL has been pressed.

   The LC display will show the CAL (flashing) and MEAN (steady). MEAN indicates that the mean value of the readings will be shown on the display.

7. Place the thicker of the two foils (this should be at least twice as thick as the other foil) on the uncoated sample, apply the probe and raise it after the bleep.

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

   To discontinue calibration, press CLEAR.

8. Adjust to the thickness of the foil with the arrow keys.

9. Press CAL. CAL will appear on the display (steady).

10. Now take readings by placing the probe on the unknown coating and raising it after the bleep.

    Read off the thickness value..

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

a) Press CAL then CLEAR to delete the existing CAL values.

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

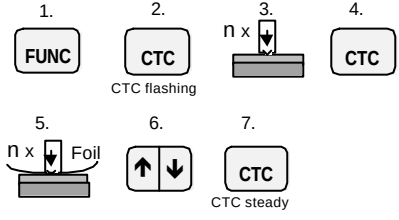
b) or restart CAL calibration be repeating steps 2 to 9 above. This automatically overwrites the old calibration and saves the new values.

3.2.5 Calibration on a coated surface (CAL-THROUGH-COATING - CTC) (MiniTest2100 only)

(Patented under license no. DE3404720C2)

This method is recommended when an uncoated test sample is not available. It can be employed with the probe types F06, F1.6, F3, FN1.6 & FN2 (F-part), F1.6/90, F2/90, F10, F20 and F50 probes.

The CTC method may, however, only be used when the coating is smooth at the calibration point and measured values are reproducible. Do **not** use for textured coatings.



1. Press FUNC then CAL / CTC to initialise CTC calibration.

   The LC display will show CTC (flashing) and MEAN (steady). MEAN indicates that the mean value of the readings will be shown on the display.

2. Place the probe on the calibration point of the test sample and raise it after the bleep.

   Apply the probe to the coated test sample several times. The display

always shows the mean value of the previous readings.

3. Press CAL
4. Lay the calibration foil on the same point, 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.
5. Adjust to the thickness of the foil with the arrow keys.
6. Press CAL. CTC will appear on the display (steady).
7. Now take readings by placing the probe on the unknown coating and raising it after the bleep.

   Read off the thickness value.
8. It may be necessary to delete the CTC calibration if, for example, an incorrect calibration value is entered. In this case:

a) Press FUNC, then CAL, then CLEAR to delete the CTC calibration.

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

   or

b) restart CTC calibration by repeating steps 1 to 6 above. This automatically overwrites the old calibration and saves the new values.

3.2.6 Calibration and measurement with the universal FN1.6 and FN2 probe

The FN 1.6 and FN2 universal probes 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 ⇧-key to select FERROUS, i.e. the magnetic induction method.

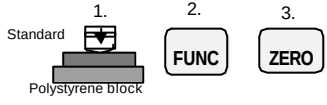
Press the ⇩-key to select NON-FERROUS, i.e. the eddy current method. If the neither key is pressed, the gauge will automatically display FERROUS after about 5 secs. and select the magnetic induction method.

For calibration and measurement, proceed as normal according to either 3.2.2 or 3.2.3 or 3.2.4 or (for the magnetic induction principle) 3.2.5.

3.2.7 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.

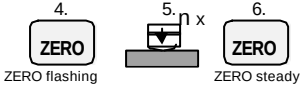
1. Standardisation



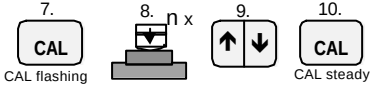
Place the probe on the thicker of the two supplied standards, without any metal underneath. To avoid any external dielectric influences, an effective base for the standard is a polystyrene block at least 3cm in thickness.
Press FUNC and then ZERO.

2. Zero and calibration

For calibration and measurement proceed as normal in 3.2.2. or 3.2.3. or 3.2.4.



(Zero set)



(Calibration as in3.2.3)

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.

3.2.8 Calibration and measurement with N100 probe

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

The base must be a minimum 30x30 cm.

With smaller areas, but not smaller than 15 x 15 cm, the measuring tolerance will be greater, as shown in the table provided.

For minimum error the following is recommended:

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

b) Make a two point calibration with two spacers.
Here the expected thickness should lie between that of the two spacers.

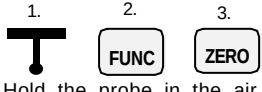
This calibration method is described in 4.2.4.

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

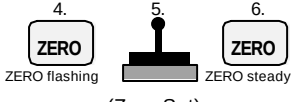
   If single measurement is required this can be activated by pressing FUNC and CONTINUE.

2. Standardisation



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

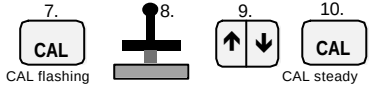
3. Zero Set



(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 0.0 mm.

4. Calibration



(Calibration as in 3.2.3)

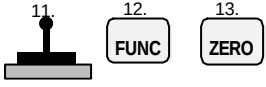
   Place the spacer supplied - e.g. 50 mm - in the recess in the base of the probe. The thickness of the spacer should be similar to that of the expected thickness to be measured.

   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, but without a metal base.

Now press FUNC and ZERO one after the other.

This procedure must be carried out after calibration methods a) and b).

6. The gauge is now ready for measurement.

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

1.) After switch off for more than two hours.
2.) After high temperature changes - more than 10°C.
3.) When the gauge is to be used on other types of material, point 5 must be repeated

3.2.9 Calibration and measurement with probe F20

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

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. By 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.

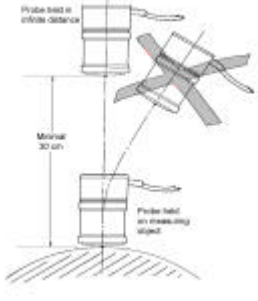
Place probe on the unknown coating and if required, take over the reading into statistic by pushing the button⇧ (see chapter 2.5.5 and 2.5.6)

3.2.10 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 a least 1m away from computers, monitors or any other magnetic data carrier.

3.2.11 Calibration and measurement with pipe probes F1.6/90, F2/90, N1.6/90 and N2/90

In single measurement mode*, proceed as normal for calibration and measurement.

In continuous measurement mode* the use of pipe probes requires a slightly different procedure:

1. Use the calibration and measurement routines described in either 3.2.2 or 3.2.3 or 3.2.4 (or 3.2.5 for F2/90

probes (MiniTest2100 only).) Calibrate in single measurement mode.

2. The last reading can be entered into the statistics memory by pressing the ⇧ key or by pressing a foot-operated switch (optional extra).

   * To switch between single measurement and continuous measurement modes press FUNC and CONTINUE“.

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

Applicable to probe types FN1.6, FN2, N1.6/90 and 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’.

3.2.13 Calibration and measurement with probe CN02

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

Only one-point calibration 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 (steady). MEAN indicates that the mean value of the readings will be shown on the display.

2. Place the metalic 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 sample thickness.

   Apply the probe to the metalic 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 (steady) will appear on the LC display.

5. Now take readings by placing the probe on the unknown coating 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 then copper:

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

3.2.14 Calibration and measurement on shot blasted surfaces.

The physical nature of shot-blasted surfaces results in coating thickness readings that are too high. The mean thickness over the peaks can be determined as follows (note that the statistics program is of great benefit in this procedure):

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, shot-blasted surface to procedure the mean $\overline{X}o$.
3. After this take approx. 10 further readings on the coated and similarly shot blasted test sample to produce the mean value $\overline{X}m$.
4. The difference $(\overline{X}m - \overline{X}o) \pm s$ is the mean coating thickness $\overline{X}_{eff}$ over the peaks ; s is the greater standard deviation of the two values $\overline{X}m$ and $\overline{X}o$.

Method B

This method should be used for surfaces with a roughness grade of $\prec$20 µm.

1. Carry out a zero calibration of 10 readings on a shot-blasted, uncoated substrate. Then calibrate with a foil on the uncoated substrate. The foil set should consist of a number of

individual foils of max. 50 microns 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. The statistics function is useful here.

Method C (MiniTest2100 only)

Calibration with two different calibration foils.

This method also gives reliable results. Simply follow the two-point calibration method using two foils as described in section 3.2.4.

The respective foil value can be reached by using several foils - 50µm each.

The mean coating thickness should be calculated from between 5 and 10 readings. The statistics programme can be useful here.

Note:
for coating thickness over 300 microns, the degree of surface roughness is of above methods can be omitted.

3.2.15 Adjusting the basic calibration

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

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

The basic calibration should be reset 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 generators or live rails with strong currents can affect the reading.

When using the statistic programme (MiniTest2100 only) for obtaining a mean value it is advisable to place the probe several times inthe relevant areas. Any false or freak readings can be cleared immediately by pressing CLEAR.

The final reading derives from:

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

Example:

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

$\overline{X}$ = mean value = 153 µm
s = Standard deviation = ±3 µm
u = gauge tolerance range,
= ± (1,5 µm + 1µm)

e.g. ±(1% of measured value + 1µm)

Th = 153 µm ± 5,5 µm

3.4 Using the foot-operated switch

In continuous mode, readings are logged to statistics memory only on request (only MiniTest 2100). Data can also be printed-out on an optional printer or transferred to a PC via an interface.

Use these functions by pressing arrow-key (⇧) or by using the optional foot-operated switch. A reading can either be entered with the key or with an optional foot-operated switch. This switch is especially helpful if the operator needs both hands for measurement, as when using pipe probes F1.6/90, F2/90, N1.6/90 and N2/90.

4. Measurement using statistics (MiniTest2100 only)

Chapter 4 only refers to MiniTest 2100!

The MiniTest 2100 gauge is equipped with two statistics programs. One is based on single-value statistics, the other on block-value (DIN 50982).

The MiniTest 2100 can calculate both single-value and block-value statistics from a series of stored measurements (max. 10 000 readings). The statistical values can be printed out either with or without a list of corresponding single values (see 4.5, 4.6, 4.7).

- **Single value statistics**
  This program automatically stores and evaluates the readings of a series. The analysis of any one series appears on the display and on the print-out as follows:

- n-values : number of single values
  mean ($\overline{x}$): mean of single values
  st.d. (s) : standard deviation
  kvar : coefficient of variation
  max : highest single value
  min : lowest single value

- **Block-value statistics**
  (see also section 2.5.4)
  The MiniTest 2100 and is provided with the block-value statistics program. In this mode the readings of a series are logged in blocks. The size of a block is alterable via PC and optional software. Default: 5 readings = 1 block. The statistics are calculated from each block. The analysis of any one series appears on the display and on the print-out as follows:

N-Groups : number of blocks or groups
MEAN ($\overline{\overline{x}}$) : mean of all mean values
ST.D ($\overline{s}$) : Standard deviation (mean)
KVAR : coefficient of variation (mean)
MAX : highest single value (mean)
MIN : lowest single value (mean)

Note:
After each block has been registered (default after every 5th reading) the gauge emits a double bleep.

At least 2 single values or 2 block values are required to produce a statistical analysis, which will consist of the 6 values listed above.

4.1 Definition of statistical values

- **MEAN** $\overline{x}$

  The mean is the sum of the single values divided by the number of readings

$$\overline{x} = \frac{\Sigma x}{n}$$

- **Standard deviation s** (STD. DEV)

  The standard deviation is a measure of the scattering of reading. The greater the scattering, the greater the standard deviation.

  S is calculated from the positive square root of the scattering s^2

  Scattering is defined as the sum of the deviations from the arithmetical mean squared, then divided by the number of measured values minus 1

$$s^2 = \frac{\Sigma(x - \overline{x})^2}{n-1}$$

$$s = \sqrt{s^2}$$

- **Kvar: coefficient of variation**

  The coefficient of variation is the standard deviation divided by the arithmetical mean. The result is expressed as a percentage.

$$K\,var = \frac{s}{\overline{x}} \times 100\%$$

4.2 Entering a series of measurements for statistical analysis

1. The gauge can be used for measurements immediately after it is switched on. All readings will be automatically logged to the statistics program.
2. Remember to check whether calibration is required and/or if any redundant statistical values need to be erased.
3. To recalibrate, simply overwrite the old calibration.
4. Any remaining statistical values can be erased by pressing FUNC and CLEAR STATS.

4.3 Deleting a false or freak reading

(see section 5 for other 'delete' commands)

1. Deletion must take place immediately after a faulty measurement and before the next measurement.
2. Press CLEAR once. A bleep confirms that the last registered value has been deleted.

4.4 Storage capacity overflow

If the storage capacity is exceeded the 6 statistical values will not be updated, although measurement can continue.

If the memory is full, subsequent readings will be omitted from the statistics. They will be marked with the error message E11..

4.5 Display and print-out of the statistical values for a series of measurements (no single value)

4.5.1 Single-v alue statistics

If single-value statistics mode is activated, (see also section 2.5.4) all readings of a series can be displayed and printed out.

1. Display statistics (without printer)

Each time STATS is pressed the statistical values will appear in the order N (values), MEAN, ST.D., Kvar, MAX, MIN.

2. Printing single statistical values

If a MiniPrint 4100 printer is connected the statistical values can be printed out or transferred via a serial interface to a PC

Each time STATS is pressed the statistical values will be printed/transferred in the order N (values), MEAN, ST.D., Kvar, MAX, MIN.

3. Complete print-out of statistical values with histogram option.

Press PRINT once

If a printer is connected to the gauge it will now print out all single readings with date, time and probe type used.

Note:
The MiniTest print-out of single-value statistics is headed STATISTICS.

To cancel printing, press OFF on the MiniPrint 4100 printer.

The statistical values can be viewed at any time, even while a series of measurements is being taken.

4.5.2 Block-value statistics

If the block-value statistics mode is selected (see also section 2.5.4) the statistical values can be displayed or printed out as required.

Note:
It is also possible to display and print out single-value statistics in this mode.

1. Display single-value statistics (without printer)

Each time STATS is pressed the statistical values will appear in the order N (values), MEAN, ST.D., Kvar, MAX, MIN.

2. Printing single-value statistics

The values can be printed out to a MiniPrint 4100 printer in the order N (values), MEAN, ST.D., Kvar, MAX, MIN, or transferred via a serial interface to a PC.

Each time STATS is pressed the statistical values will be printed out or transferred to a PC.

3. Display of block-value statistics (without printer)

Press PRINT once.

The 6 block-value statistics will appear for just over a second at a time in the order N (groups), MEAN, ST.D., Kvar, MAX, MIN.

4. Display block-value statistics and print out all statistical values.

Press PRINT once.

The 6 block-value statistics will be displayed for just a second at a time. If a printer is connected to the gauge it will simultaneously print out the block-value statistics with date, time and probe type used.

Note:
The MiniPrint print-out of block-value statistics is headed:
BLOCK-STATISTICS

To cancel printing, press OFF on the MiniPrint 4100 printer.

The statistical values can be viewed at any time, even while a series of measurements is being taken.

4.6 Print-out of all statistical values and all readings of a series.

4.6.1 Single-value statistics

If single-value statistics mode is activated, (see also section 2.5.4) all individual readings of a series and the accompanying statistics can be displayed and printed out as follows:

Press FUNC and PRINT ALL.

If a printer is connected the following will be printed out:

- all readings of a series
- the 6 single-statistics values

Note:

1. Pressing FUNC and PRINT ALL will result in a print-out of all readings and statistical values.
2. Pressing PRINT will result in a print-out of statistical values.
3. To cancel the print-out of readings. Press OFF on the MiniPrint 4100 printer.
4. The readings on the display and the print-out are rounded off.

4.6.2 Block-value statistics

If block-value statistics mode is activated. (See also section 2.5.4) the corresponding statistical values and all individual readings of a series can be displayed and printed out as follows:

1. Display all block-value statistics (without printer)

The display is identical to that described in section 4.5.1 paragraph 3.

Press FUNC and PRINT-ALL

The 6 (8) block-statistics values will appear for just over a second at a time in the order N (groups), MEAN, ST.D., Kvar, MAX, MIN.

2. Print-out of all readings of a series, the statistics of each block and all block-value statistics.

Press FUNC and PRINT-ALL

If a printer is connected the following will be printed out:

- all readings of a series

- the values MEAN, St.D and N (number of readings per block)

- the 6 block-statistics values and

Note:

1. Pressing FUNC and PRINT-ALL will result in a print-out of all readings and statistical values.
2. Pressing PRINT will result in a print-out of statistical values only.
3. To cancel the print-out of readings, press OFF on the MiniPrint 4100 printer.
4. The readings on the display and the print-out are rounded off.

Table of displays and print-outs possible for single-values and block-value statistics (MiniTest2100 only)

	Single-value statistics activated		Block-value statistics	
	Display	Print-out	Display	Print-out
STATS-KEY *MiniTest 2100*	only single-value statistics after pressing STATS	only single-value statistics after pressing STATS	only single-value statistics after pressing STATS	only single-value statistics after pressing STATS
PRINT-KEY *MiniTest 2100*	-	complete print-out single-values statistics (includes time and date)	block-value statistics (running display, approx 1.2. seconds per reading)	complete print-out block-values statistics (includes time and date)
PRINT ALL-KEY *MiniTest 2100*	-	complete print-out of all readings of a series and single-value statistics (also time and date)	block-value statistics (running display, approx 1.2. seconds per reading)	complete print-out of all readings of a series and block-value statistics (also time and date)

Example of print-out of single-value statistics

ELEKTRO-PHYSIK	
STATS. PROGRAM	
01-DEC-97 15:51	date of print-out
Probe F3	probe type
01-DEC-97 12:28	date of first reading
STATISTICS	
n-values 97	number of readings
mean 199 um	mean value
st.d. 4.3 um	standard deviation
kvar 2.1 %	coefficient of variation
max 206 um	highest reading
min 189 um	lowest reading

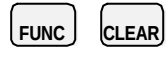
5. 'Delete' functions

5.1 Deleting the last reading taken:

Press the CLEAR pad once immediately after a reading has been taken. A short bleep confirms the reading has been deleted.

5.2 Deleting statistics

- for the MiniTest 2100



5.3 Deleting all series of measurements including associated statistics. (Statistics MiniTest2100 only) Reset of basic settings to default values (delete all)

1. Switch off gauge.
2. Press and hold down the CLEAR, FUNC and ON keys. Press these keys

one after the other and hold all three down.

A long bleep confirms deletion of all data.

6. Using the gauge without probe

Certain gauge functions can be activated without a probe being connected. These are as follows:

1. Defining the initialising function and standard gauge settings.
2. Print-out of statistics and readings
4. Gauge control via a PC (see section 9).

7. The MiniPrint 4100 data printer

The portable MiniPrint 4100 is fitted with 4 built-in NiMH accumulator batteries. The power pack supplied with the gauge is sufficient to recharge the batteries.

Before connecting the printer MiniPrint 4100 to the mains unit please make sure that the rechargeable NiMH batteries are inserted in the printer.
If non-rechargeable alkaline batteries are inserted, they might explode and thus injure the user.

A fully loaded accumulator will last for several thousand lines of print. Loading time is approximately 14 hours. The battery state is indicated by two LED's. The red LED (low) indicates battery discharge. If the power pack is connected, the yellow LED (charge) indicates that the accumulator batteries are being charged. As soon as the yellow LED goes off, battery charging is completed. The MiniPrint 4100 is fitted with an internal charging control preventing the accumulator battery from being discharged or overcharged.

A special power pack for quick charging which can be provided as an option allows quick charging of the NiMH accumulator batteries within one The MiniPrint 4100 printer will provide an instant or later print-out of:

- single values
- statistical values (MiniTest 2100 only)

1. Connect printer to MiniTest gauge.
2. Switch on the MiniTest gauge (ON).
3. Now activate the required operating mode (ON / OFF).

Please note:

All MiniTest gauge functions are blocked while printing is in progress.

The printer will stop working if OFF is pressed (green LED goes off).

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

When the MiniTest switches itself off automatically, the printer status -either ON or OFF- 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 MiniPrint are switched on.

7.1. Changing the paper roll

1. The MiniTest and the MiniPrint should be connected.
2. Switch on the MiniTest.
3. Activate the MiniPrint by pressing ON / OFF-key (green LED lights up).
4. Press FEED to remove any remaining paper.
5. Remove Plexiglas slider from printer.
6. Remove empty paper roll and insert new one.
7. Cut off the end of the new roll cleanly and insert the end into the slit at the bottom while pressing FEED.
8. The printer mechanism will now draw the paper through.
9. Press FEED until the end of paper strip comes out.
10. Draw out paper for approx. 10 cm and insert into the Plexiglas cover.
11. Keep paper end at Plexiglas slider and insert Plexiglas cover again.

7.2. 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. Remove Plexiglas slider from printer.
2. Now draw the paper strip out of the printer.
3. Locate the point on the right marked „PUSH“ and press. This releases the other end of the cartridge from the cog pin.

4. The cartridge may now be removed without difficulty. A new cartridge can be inserted by reversing the instructions above.
5. Tighten the ribbon by turning the notched knob of the new cartridge in the direction of the arrow.
6. Tilting the cartridge slightly, slip it over the cog pin.
7. Clip in the other end, making sure that the ribbon is taut and fed horizontally into the paper slot.
8. Now insert paper as described under 7.1.

7.3 Quick charging function for NiMH accumulator batteries

The optional power pack allows quick recharge of accumulator batteries. Remove NiMH accumulator batteries from the MiniPrint 4100. Insert batteries into power pack. The MiniPrint is fitted with a set of four NiMH accumulator batteries. Two of them are located in the battery case on the back of the printer, the others are located under the paper roll.

1. Put the printer with the front panel on a base.
2. Use a screw driver for recessed-head screws to loosen the screws of the battery casing.
3. Lift cover of battery casing.
4. Remove NiMH accumulator batteries.
5. To remove the two other batteries remove the Plexiglas slider.
6. Remove paper roll from its casing. It is not necessary to remove the paper from printing mechanism.
7. Push the side panels of the paper roll casing to lift the casing. Remove battery support from casing to take out the NiMH accumulator batteries.
8. Insert the 4 NiMH accumulator batteries into the quick loading power pack for recharging.

Note: Please observe the right polarity when inserting the batteries.

9. After battery charging has been completed place the batteries again into battery support and insert it into

the battery casing. Then carry out instructions 1-8 in reverse order.

7.4 Printer Self-Test

The MiniPrint 4100 features a printer self-test function.

1. Connect MiniPrint 4100 to MiniTest (1100/2100) gauge. Then switch on the MiniTest gauge.
2. Press ON/OFF key until the green LED goes off.
3. Keep FEED key pressed down, then press ON/OFF key.
4. To deactivate this function press ON/OFF-key.

8. Connecting a PC (IBM and compatible)

The MINITEST 1100 and 2100 gauges have a combination interface which can accommodate a MiniPrint 4100 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.

Note on the Mitutoyo printer DP1-HS:

The Mitutoyo printer works on its own statistics function. MiniTest statistics programs cannot be printed out on the Mitutoyo.

9. 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.

10. Combination interface for foot-operated switch, bleeper or lamp (optional)

This optional interface makes available:

- an external trigger mechanism which enters readings in continuous mode 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.

11. Interface details for the MiniTest and MiniPrint

A full description will be provided on request.

12. Useful accessories

- Special-purpose probes
- In-service carrying case
- Clear-view cover for dust protection
- Double case for MiniTest and MiniPrint
- MiniPrint 4100, portable printer
- Connecting cable MiniTest / PC
- Program disk: processes MiniTest readings and statistics. For IBM PC or compatible
- Precision stand for high-precision readings and measurements on small components
- Mains adapter 220V AC/12V DC or 110V AC/12V DC
- Accumulator and battery charger 220V AC or 110V AC

13. 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.

14. 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.

15. Additional gauges and detectors

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

- non-magnetic or nickel coatings on steel using the magnetic attraction principle (MIKROTEST type)
- galvanised coatings on all substrates using the coulometric principle (GALVANOTEST type) and the X-ray fluorescence principle (XRF200 type).

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

- insulating coatings on all metals and
- insulating coatings on concrete

16. 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:

E 01 : Probe type incompatible.

E 02 : Probe not connected. This message only appears when no probe is connected after a total reset.

E 03 :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.

E 04 : Probe is giving unreliable readings (e.g. as a result of strong fluctuations in the magnetic field or readings taken on soft coatings)

E 05 : Probe was held too near metal when switched on

E 06 : Battery voltage too low.

Error messages displayed for about 1.5.secs:

E 11 : Memory full.

E 12 : ZERO calibration not possible.

E 13 : CTC calibration not possible.

E 14 : Cal2 calibration not possible.

E 15 : .One-point calibration after CTC calibration not possible.

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

the switch 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 all readings, calibration values and limits have been deleted.

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

17. EC declaration of conformity

We declare that the gauges MiniTest 1100 and MiniTest 2100 as well as the data printer MiniPrint 4100 are in correspondence with the safety requirements of the EMC directive 89/336/EWG, which is applied through the German law for electromagnetic conformity (EMVG) dated 9.11.1992.

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19. Example of how to operate the MiniTest 1100 and 2100

Probes available:
F1.6, F3; F1.6/90, F2/90; F10
N 1.6, N2; N1.6/90, N2/90; N10
FN1.6, FN2 (universal probes)

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 probes FN1.6 or FN2.:

-FERROUS flashes on the display.

-For measurements on iron and steel: Press (⇧).

FERROUS appears with µm or mm.

-For measurements on non-ferrous metals: press (⇩) within 4 sesc.

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.

End of sample instructions for the MiniTest 1100 / 2100

Metric Units
Technical data on probes for use with the MiniTest

Probe	F 06	F 3	F 2/90 internal pipe probe	F 10	F 20	F50	FN 2 for steel and non-ferrrous substrates	N 2	N 2/90 internal pipe probe	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…3 mm	0…2 mm	0…10mm	0…20mm	0…50mm	0…2mm 0…40 µm Cr on Cu	0…2 mm		0…10mm	0…20mm	0…100mm	10…200µm
Low range resolutiont	0.1µm	0,2µm		5µm	10µm	0,01mm	0,2µm			10µm	10µm	0.1mm	0.2µm
Guaranteed ²) tolerance	± (1...% +0.7um)	± (1…% +1µm)		± (1...% +10um)	± (1...% + 25um)	± (3% +0.05m	¹) Tolerance percentage based on measured value ³) ± (1…% +1µm)			± (1...% + 25um)	± (1...% + 50um)	± (1..% + 0.3mm)	± (3% +1µm)
Minimum curvature radius	convex 1.5mm	1.5mm	flat	5mm	10mm	50mm	1.5mm		flat	25mm	25mm	100mm	flat parts only
	conkav 5mm	10mm	6mm	16mm	30mm	200mm	10mm			100mm	100mm	flat	
Minimum area for measurement	3mm dia	5mm dia	5mm dia	20mm dia	40mm dia	300mm x 300mm	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	8 x 9 x 170	28 dia x 48	44 dia x 65	45 dia x 71	15dia x 62		13 x 15 x 160	50dia x 72	65dia x 75	126dia x155	16dia 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 obtainded if gauge is calibrated with standard of expected thickness.

²) Based on manufacturer's standards.

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

Metric Units
Technical data on probes for use with the MiniTest

Probe	F 1.6	F 1.6/90 internal pipe probe	FN 1.6 for steel and non-ferrous substrates	N02	N 1.6	N 1.6/90 internal pipe probe
Principle	magnetic induction			Eddy current		
Measuring range	0...1.6 mm		(0...40µm Cr on Cu)	0...0,2 mm	0...1.6 mm	
Low range resolutiont	0.1 µm					
Guaranteed [2] tolerance	± (1...% +1µm)			± (1...% + 0,5µm)	± (1...% +1µm)	
[3] Measuring sample: Minimum curvature radius	1,5mm	flat	1,5mm	1,0mm	1,5mm	flat
	10mm	5mm	10mm			
[3] Measuring sample: Minimum area for measurement	5mm dia	5mm dia	5mm dia	2mm dia	5mm dia	5mm dia
[3] Measuring sample: Minimum base thickness	0,5mm		F: 0.5mm N: 50µm	50 µm		
Dimensions in mm	15 dia x 62	9 x 9 x 170	15dia x 62	16dia x 70	15dia x 62	13 x 15 x 160

Power supply:
1 x 9 V alkaline battery (more than 10.000 measurements),
adapt NiCd-battery, mains adapter
Standards:
DIN 50981, 50982, 50984 / ISO 2178, 2360 / BS 5411 / ASTM B499, B244

Ambient temperature: gauge 0...50 °C; probe -10°C...+70°C, briefly to 120°C

Dimension / weight of gauge: 150mm x 82mm x 35mm, 270g

[1] Better tolerance can be obtainded if gauge is calibrated with standard of expected thickness.

[2] Based on manufacturer's standards.

[3] A two-point calibration becomes neccessary if several minimum requirements are appliicable (minimum curvature radius and/or minimum area for measurments and/or minimum base thickness).

Imperial Units (USA)
Technical Data on probes for use with the MiniTest

Probe	F 06	F 3	F 2/90 internal pipe probe	F 10	F 20	F 50	FN 2 steel and non-ferrous substrates	N 2	N 2/90 internal pipe probe	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…24 mils	0...120mils	0...80mils	0...400mils	0...800mils	0...2"	0.....80mils (0..1.6mils Cr on Cu)	0...80mils		0...400mils	0...800mils	0...4"	0.4…8mils
Low range resolutiont	0.01mils	0.02mils		0.5mils	1mils	1mils	0.02mils			1mils	1 mils	10mils	0.02 mils
Guaranteed [2] tolerance	[1] Tolerance percentage based on measured value [1]												
	± (1...% + 0.03mils)	± (1...% + 0.04mils)		± (1...% +1mils)	± (1...% + 1mils)	± (3% + 2mils)	± (1...% + 0.04mils)			± (1...% + 1mils)	± (1...% + 2mils)	± (1...% + 12mils)	± (3% + 0.04 mils)
[3] Measuring sample **Minimum curvature radius**	convex 0.06"	0.06"	flat	0.2"	0.4"	2"	0.06"		flat	1"	1"	4"	flat
	conkav 0.2"	0.4"	0.25"	0.65"	1.2"	8"	0.4"		0.4"	4"	4"	flat	parts only
Minimum area for measurement	0.12"dia	0.2"dia	0.2"dia	0.8"dia	1.6"dia	12" x 12"	0.2"dia		0.2"dia	2"dia	2.8"dia	6"dia	0.3"dia
Minimum base thickness	8 mils	20 mils		40 mils	80 mils	80 mils	F: 20 mils N: 2 mils	2 mils					no limit
Dimensions	0.5"dia x 2.2"	0.6"dia x 2.5"	0.32"x0.35"x6.4"	1.1"dia x 1.9"	1.7"dia x 2.6"	1.8"dia x 2.8"	0.6"dia x 2.5"		.52" x .6" x 6.3"	2"dia x 2.8"	2"dia x 3"	5"dia x 6.1"	0.63"dia x 2.7"

Power supply:
1 x 9 V alkaline battery (more than 10.000 measurements), adapt NiCd-battery, mains adapter

Ambient temperature: gauge 32...122°F; probe 14...158°F, briefly to 248°F

Standards:
DIN 50981, 50982, 50984 / ISO 2178, 2360 / BS 5411 / ASTM B499, B244

Dimension / weight of gauge: 5.9" x 3.2" x 1.4" 9.5" ozs

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

[2]) Based on manufacturer's standards.

[3]) A two-point calibration becomes neccessary if several minimum requirements are appliicable (minimum curvature radius and/or minimum area for measurments and/or minimum base thickness).

Imperial Units (USA)
Technical Data on probes for use with the MiniTest

		F 1.6	F 1.6/90	FN 1.6	N02	N 1.6	N 1.6/90
Probe			internal pipe probe	steel and non-ferrous substrates			internal pipe probe
Principle		magnetic induction					
Measuring range		0...63 mils		(0...1.6mils Cr on Cu)		0...63 mils	
Low range resolutiont		0.01mils					
Guaranteed [2] tolerance		± (1...% + 0.04mils)			± (1...% + 0.04mils)	± (1...% + 0.04mils)	
[3] Measuring sample	**Minimum curvature radius**	0.06"	flat	0.06"	0.04"	0.06"	flat
		0.4"	0.25"	0.4"			0.4"
	Minimum area for measurement	0.2"dia			0.08"dia	0.2"dia	
	Minimum base thickness	20 mils		F: 20 mils N: 2 mils	0.6"dia x 2.5"		
Dimensions		0.6"dia x 2.5"	0.32"x0.35"x6.4"	0.6"dia x 2.5"	0.6"dia x 2.8"	0.6"dia x 2.5"	.52" x .6" x 6.3"

Power supply:
1 x 9 V alkaline battery (more than 10.000 measurements), adapt NiCd-battery, mains adapter
Standards:
DIN 50981, 50982, 50984 / ISO 2178, 2360 / BS 5411 / ASTM B499, B244

Ambient temperature: gauge 32...122°F; probe 14...158°F, briefly to 248°F

Dimension / weight of gauge: 5.9" x 3.2" x 1.4" 9.5" ozs

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[3]) A two-point calibration becomes neccessary if several minimum requirements are appliicable (minimum curvature radius and/or minimum area for measurments and/or minimum base thickness).

Schnittstelle Schichtdickenmeßgeräte **MiniTest 1100** und **2100**

9Poliger D-SUB-Steckverbinder, Buchse

Steckerbelegung: Norm RS232C

PIN-Nr.

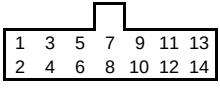
1:	-	6:	-
2:	RXD ⇨	7:	-
3:	TXD ⇦	8:	-
4:	-	9:	-
5:	GND		

Einstellparameter:

Baudrate:	9600
Datenbits:	8
Stopbits:	1
Parity:	none

Schnittstelle Datendrucker **MiniPrint**

Belegung



Steckerbelegung:

PIN 1:	GND
PIN 4:	DATA
PIN 5:	BUSY
PIN 6:	ON/OFF-Ansteuerung

Einstellparameter:

Baudrate:	1200
Datenbits:	8
Stopbits:	1
Parity:	none

Interface Coating Thickness Gauge
MiniTest 1100 and **2100**

9channel D-SUB-Connector, Socket

Pin allocations: RS232C

PIN-Nr.

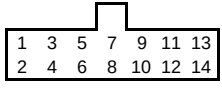
1:	-	6:	-
2:	RXD ⇨	7:	-
3:	TXD ⇦	8:	-
4:	-	9:	-
5:	GND		

Transmission parameters:

Baudrate:	9600
Databits:	8
Stopbits:	1
Parity:	none

Interface Data Printer **MiniPrint**

Pin assignment



Pin allocations:

PIN 1:	GND
PIN 4:	DATA
PIN 5:	BUSY
PIN 6:	SELECT IN

Transmission parameters:

Baudrate:	1200
Databits:	8
Stopbits:	1
Parity:	none

Servicekarte

Sehr geehrter Kunde,

Sie haben sich für ein Schichtdicken-meßgerät aus dem Hause ELEKTRO-PHYSIK 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

Technische Änderungen vorbehalten

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