ElektroPhysik

Technical Manual / Operating Instructions

Coating Thickness Gauges

MiniTest 720, 730, 740

ElektroPhysik
Dr. Steingroever GmbH & Co. KG
Pasteurstr. 15
50735 Köln
Deutschland
Tel.: +49 221 752040
Fax.: +49 221 7520467
Internet: http://www.elektrophysik.com/
Mail:: info@elektrophysik.com

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1. Introduction

Designed for non-destructive coating thickness measurement, the models of the MiniTest 700 series may be connected to different sensors. According to sensor, they work on the magnetic induction principle or on the eddy currents principle. All models of the MiniTest 700 series conform to the following industrial norms and standards:

DIN EN ISO 1461	ASTM B244	AS 3894.3-2002
DIN EN ISO 2064	ASTM B499	SS 18 41 60
DIN EN ISO 2178	ASTM D7091	SSPC-PA 2
DIN EN ISO 2360	ASTM E376-03	
DIN EN ISO 2808		
DIN EN ISO 19840		

The portable gauges are suitable for non-destructive, quick and precise coating thickness measurement. Easy to handle they are the ideal tool for the finishing industry, electroplating, ship and bridge building, aircraft construction and the engineering and chemical industry.

The measuring system comprises a sensor and a display unit. According to model, the gauge features a built-in sensor, an external sensor or a convertible sensor.
Three basic models are available:

MiniTest 720 with **built-in** sensor

MiniTest 730 with fixed **external** sensor

MiniTest 740 with convertible senor (can be changed from built-in to external on a lead). All sensors of the MiniTest 700 series may be connected to this model.

According to probe type, the gauges are suitable for measuring the following substrate/coating combinations:

The **F** sensors work on the magnetic-induction principle and are suitable for measuring non-magnetic coatings such as paint, enamel, rubber, aluminium, chrome, cupper, tin etc. on ferrous bases and steel (also on alloyed steel or on hardened magnetic steel, but not on austenitic steel or weak magnetic steel).

The **N** sensors work on the eddy currents principle and are suitable to measure insulating coatings such as paint, anodising, ceramics, etc on all kinds of non-ferrous metals such as aluminium, cupper, zinc diecasting, brass etc. as well as on austenitic steel.

The **FN** sensors work on both, on the magnetic-induction principle as well as on the eddy currents principle. These sensors can be used for measurement on steel as well as on on-ferrous metall substrates.

For printing out readings and statistics a portable printer MiniPrint 7000 is available as an option. All models of the MiniTest 700 series are equipped with an IrDA port (infrared) to enable data communication to a PC or the MiniPrint 7000 data printer.

2. First Steps

This section refers to persons to use the gauge for the first time. This section explains the main features of the gauge and how to take readings.

2.1 Insert batteries and connect sensor

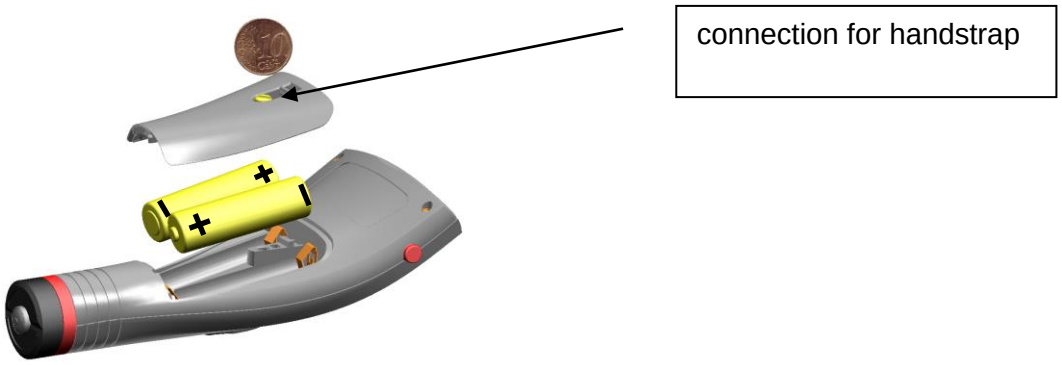
a) Take gauge and batteries from the case.

b) Loosen the screw of the battery compartment on the back-side of gauge and open the battery compartment lid (e.g. by using a coin).

c) Insert the batteries supplied with the gauge into the battery compartment. Respect polarities (as shown below).

d) Close lid and fix screw of battery compartment lid.

e) Above the battery compartment screw, a connection for fixing the hand-strap is located. The hand-strap comes with the gauge and can be fixed now.

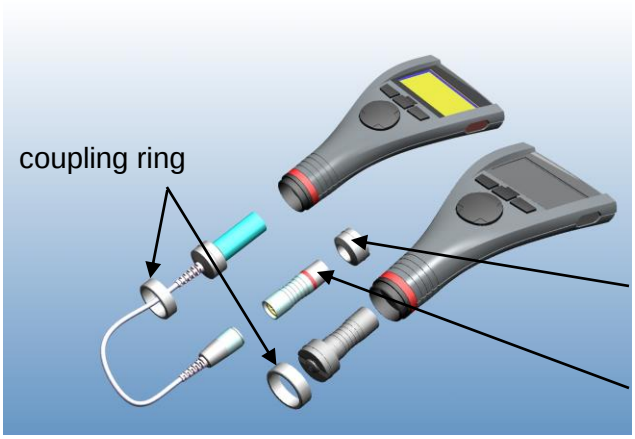


If you have purchased the MiniTest 720 or 730 model, please jump step f).

f) The MiniTest 740 model can be used with both, built-in and external sensor. The gauge comes with the adapter cable fixed to the gauge for use with the external sensor.
For using the MiniTest 740 with external sensor, fix the sensor to the adapter cable. The MiniTest 740 sensors come with tow different types of measuring prisms: one with a small contact surface for measuring small or curved parts, the second prism with a large contact surface for large and even surfaces. The large prism serves also for fixing the sensor to the MiniTest 740.

- Use of MiniTest 740 with the external sensor

  Connect sensor to adapter cable and screw in tight. The MiniTest 740 sensors come with two prisms each, one for small curve radii and one for large radii and large surfaces. Select a suitable prism according to your setting of task and fix it to the sensor.



- Use of MiniTest 740 with built-in sensor

  Turn coupling ring to remove it from gauge. Remove adapter cable. Fix the large prism to the sensor. Insert it into the gauge. Use coupling ring to screw in tight. The sensor can be mounted to the gauge housing at any angle. Adjust the prism as requested for your setting of task and fix firmly.

2.2 Switch-ON and take readings

Please note: The following steps to perform the initialising sequence need only be performed at initial use.

1. The gauge must be switched OFF.
2. Press ON/OFF button on the left side of gauge and ESC key simultaneously.
3. Release ON/OFF button first.

The initialising sequence consisting of the following four steps will be launched:

Language

English as factory set appears.

Use arrow up/down keys to adjust to the requested language.

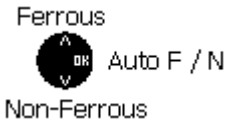
Press OK to confirm or ESC to abort and to go back to the previous setting.

If you abort, the factory setting (English) remains.

Total Reset	Press OK to confirm.
IrDA- Port (cont. active)	Press OK to confirm “cont. active”
Power supply (Battery)	Press OK to confirm.

For more detailed information on the initialising sequence please refer to section 10.1.

The Start screen appears showing gauge model and sensor type being connected (see fig. on the left)



With the FN sensors, the measuring method can be selected:

- Press arrow up key for “Ferrous” (F for magnetic induction method)
- Press arrow down key for “Non-ferrous” (N = eddy currents method).
- Press OK to confirm your selection.

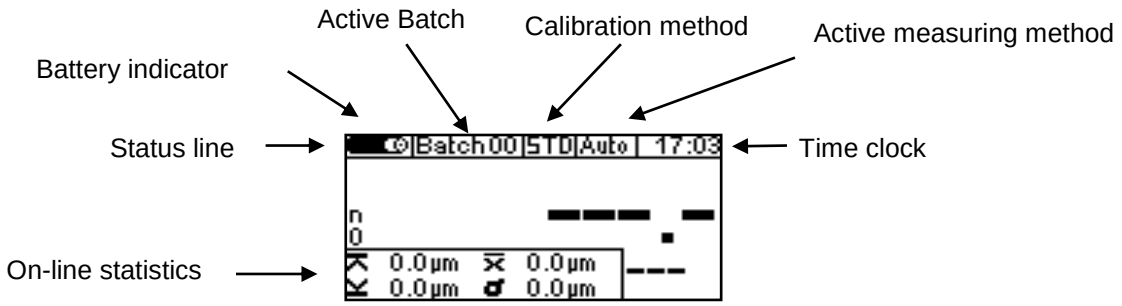
If you make no selection at all, the Auto F/N method will be automatically adjusted after 5 seconds (see fig. on the left).

a) Now the gauge is in the measure mode (see fig.) and ready for measurement (see fig.). The measure screen appears. Readings are not yet available.

b) At initial use, “Batch 00” (see section 7.2.2) and the factory calibration (“STD”) are preset. For further information on “Calibration”, please refer to section 6. The active batch and the calibration mode are shown in the status line.

c) The factory calibration is recommended for quick and easy measurement and if a medium measuring accuracy is sufficient. For more details on calibration methods please refer to section 6.2.

d) To take readings, place the sensor in right angle onto the measuring object. The coating thickness will be immediately displayed on the screen. Remove sensor and take next reading.



3. Description of the Measuring System

3.1 Gauge

3.1.1 General

Graphics display
128 x 64 dots

LED, green to confirm acquisition of readings, red to indicate if limits have been exceeded

Large backlit graphics display for convenient reading of readings and statistical values.

The gauge is equipped with a sturdy, scratch-resistant plastics housing.

3.1.2 Operating keys

ON / OFF
button

Command and
navigation block

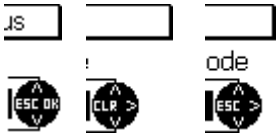
Function keys

Press **ON/OFF button** to switch the gauge ON or OFF. If you press **ON/OFF** button and **ESC** simultaneously, the initializing procedure will be performed (for more details please refer to section 10.1).

Press **Function key** CAL to start the calibration procedure.
Press **Function key** MENU to call
Press **Function key** STAT to call the statistics menu

The **command and navigation key block** has the following functions:

- Press OK to confirm settings or select menu items.
- Press ESC to abort actions, to quit submenus or to navigate through a batch.
- Use ARROW up/down keys to navigate through a menu or to change settings.
- ESC and OK keys assume various functions according to the currently active menu



The navigation block symbol indicates the function of keys they currently assume.

ESC and OK may assume different functions depending on the menu being active.

So ESC may assume delete function (CLR) and OK may assume “>” function for “next step”.

3.1.3 Infrared port

Please refer to sections 8.2 and 10.1

3.1.4 Power Supply

3.1.4.1 Batteries and Rechargeable batteries

All models, MiniTest 720, 730 and 740 are powered by a set of two alkaline-manganese cells, 1.5V, AA LR6 size (batteries are included in the standard supply schedule).
As an alternative, all models may also be operated on rechargeable NiMH (type AA-HR6) rechargeable batteries. Please use only products as recommended by ElektroPhysik (See section 13.3, Accessories).

If you are using the rechargeable batteries, the power source setting must be adjusted accordingly. (see section 10.1). For charging the rechargeable batteries, an external charger unit (available as an option) must be used.
For more details on battery use please refer to section 12.1.1.

Note:

- Remove batteries or rechargeable batteries from the instrument if not in use for extended periods.
- The battery symbol indicates 5 different battery states.

- When reaching the lowest battery state, the message “Battery almost empty” appears. In this state, voltage is insufficient for powering the display backlight. The message “Backlight failure – replace battery” appears on display.
- If batteries are completely discharged, the message “Low battery” appears and the gauge switches off.
- Insert fresh batteries within one minute immediately after removing the used ones. If you wait for longer than one minute, the message “Check clock settings” will appear (see section 9.4). However, readings and calibration values will remain in memory.
- For field use, replacement batteries should be always at hand.
- Erratic readings due to low battery do not occur as the gauge switches off automatically or does not switch on at all if batteries are too low.
- Used or defective batteries or rechargeable batteries may contain hazardous substances and must be disposed of according to the legal provisions of your country.

3.2 Sensors

3.2.1 SIDSP® technology

SIDSP® is world wide leading technology for coating thickness sensors developed by ElektroPhysik. With this new technology, ElektroPhysik has set another new benchmark for innovative coating thickness measurement.

SIDSP® stands for Sensor-Integrated-Digital-Signal-Processing – a technology where the signals are completely processed into digital form inside the sensor.

Unlike conventional techniques, the SIDSP® sensors create and control the excitation signals for the sensor head inside the sensor. The return signals are directly digitally converted and processed at a 32 bits accuracy to give you the complete coating thickness value. For this technique, highly sophisticated methods of digital signal processing are used. This enables to achieve a signal quality and precision unmatched so far with analogue signal processing.

SIDSP® sensors display extremely high interference immunity.

Anything that has to do with measuring signals will be handled by SIDSP® in direct proximity to the sensor head. No more interference during data transmission of the measuring signals via asensor cable– because with SIDSP® there is no measuring signal transmission taking place via the senor cable. The sensor cable only supplies power to the sensor and serves as a communication interface transmitting the coating thickness values to the display unit - in digital form.

All sensors feature an extremely wear-resistant sensor tip being most suitable also for hard coating materials.

3.2.2 MiniTest 740 Sensors

For this model, a range of convertible sensors is available to cover the different measuring ranges and applications. See also section 13.2.4 further details.

4. User Interface

4.1 Switch-ON and Start screen

At switch-on, the start screen appears showing gauge version and sensor version being connected.

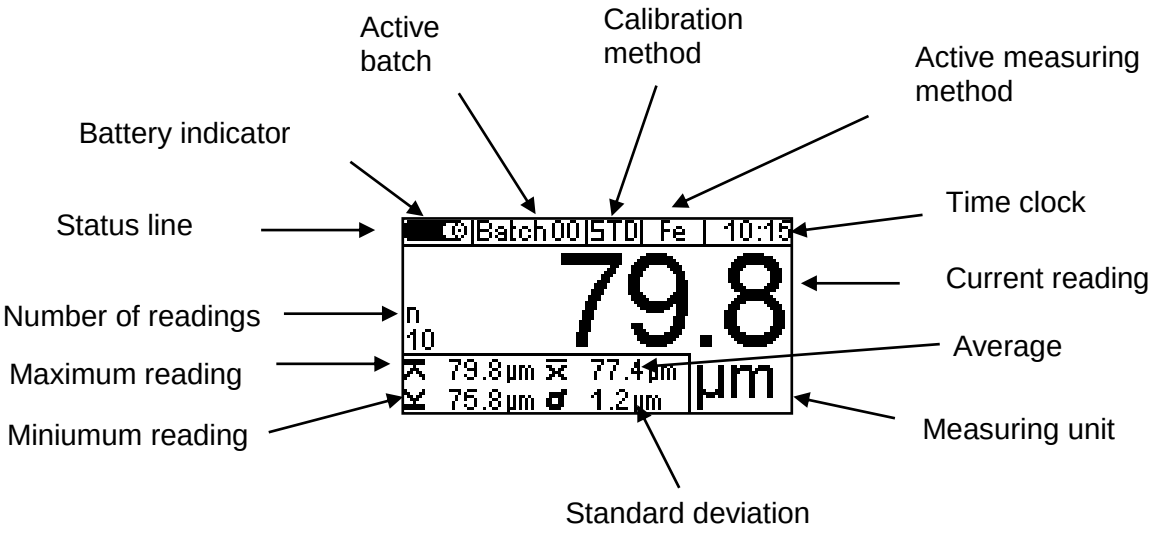
Approximately 2 seconds after switch-on, the gauges switches to the measuring mode of the last-activated batch.

If an FN sensor is connected and if no readings have been taken so far, you can choose the measuring principle via the keyboard.

Press arrow up key for Ferrous (F) (magnetic induction method) .
Press arrow down key for non-ferrous (N) substrates (eddy currents method).

If you press OK, the Auto F/N mode (with automatic substrate identification) will be activated.
If you make no selection at all, the Auto F/N mode will be adjusted automatically after approximately 5 seconds. In the Auto F/N mode, the gauge automatically identifies the substrate material to adjust to a suitable measuring principle (magnetic induction or eddy currents).

4.2 Measure Mode Screen



4.2.1 Online Statistics

When taking readings, the measuring screen shows the current statistics of the active batch in a separate window.

4.2.2 Rotatable display

In the measuring mode you can rotate the display by 180°.
Press the arrow up/down keys to rotate.

4.4 Menus

The numerous MiniTest features can be accessed via the hierarchic structure of the main menu. The main menu is subdivided into three submenus: “CAL” (calibration menu), “Menu” (main menu) and “STAT” (statistics menu). These menus can be accessed via the CAL, Menu and STAT keys.

Press the Function key **Menu** to access the main menu.

Use arrow keys to select an item from the menu, e g. „SIDSP“.

Press OK to confirm your selection.
A submenu will open or a function will be called. (e. g “Print”).

To go back to the previous menu level press ESC.

The parameter and data grouped as grouped under the various menus and submenus may be divided into three categories:

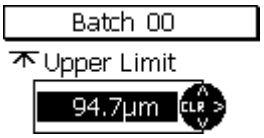
- predefined parameters that may be selected from a list
- numerical parameters that may be adjusted within predefined limits
- fixed parameters that may only be viewed but not changed

4.4.1 Setting predefined parameters

Use arrow up / down keys to scroll through the list of options of the main menu.
Press OK to confirm you selection, e.g. “Language”.
Press OK to confirm.
Use arrow up / down keys to select a language.
Press OK to confirm. Your selection has been enabled.

To abort, press ESC before confirming your selection.
You will go back to the language selection level.

4.4.2 Setting Numerical Parameters



Numerical parameters can be changed within their predefined ranges.. Use arrow up / down key to change as requested.

If there is no predefined value available (display will show „---.--"), press arrow up key to show the maximum value and arrow down key to show the minimum value.

A brief pressing of arrow up / down keys will change the value to the next increment. Pressing arrow keys continuously will increase the setting speed accordingly (as with the repeat functions of PCs).

Press OK to confirm your setting or ESC to abort and to return to the previous menu.

5. Measuring

5.1 Important Notes on Coating Thickness Measurement

Make sure the operator has been properly instructed regarding the use of coating thickness gauges and has basic knowledge of the specific requirements for measurement of the application. The operator should have basic knowledge of the following:

- Appropriate selection of a measuring device suitable for his application
- Fundamentals on the electro-magnetic measuring principle
- Influences trough magnetic fields and the surrounding fields
- Influence through the surface properties of the object to be tested (roughness, shape and build-ups on the surface)
- Statistical evaluation of measuring series

5.1.1 Interpretation of readings

The information obtained from the coating thickness measurement only refers to those parts of the test object that have been covered by the sensor. For that reason, conclusions may not be drawn on parts of the measuring object that have not been covered by the sensor during measurement. In general, such conclusions are only admissible if comprehensive experience and approved methods of statistical data acquisition are available.

5.2 Necessary Settings

Before taking readings, it is necessary to make a few settings in the “Data base” menu and the “Batch” submenu.

5.2.1 Batch

With the MiniTest 700 series, readings are basically grouped into batches. A reading that has been taken will be listed and stored into the currently active batch. After a switch-off, the gauge will call the last used batch so that you can conveniently continue to take readings in the last used batch.

You can choose from the following batch actions:

- Continue to take readings in the active batch
- Create a new batch in the data base (see section 7.2.2)
- Select an existing batch form the data base (see section 7.2.3)

5.3 Preparing Measurement

5.3.1 Calibration

According to your setting of task, you may use different calibration methods. Measuring accuracy depends on the selected calibration method. Please refer to section 6.2 for more details on this issue.

The following calibration methods are available:

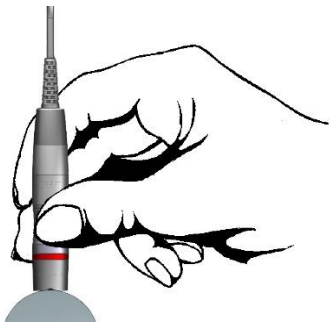
- Factory calibration
- Manual calibration
- Zero calibration
- Two-point calibration
- Multi-point calibration
- Preset calibrations „SSPC-PA2“, „Australian“, „Swedish“, „ISO“ and „Rough”

5.4 Taking readings

5.4.1 Taking readings without using the sensor stand

All sensor systems are spring-mounted to ensure a safe contact pressure on the measuring object without tilting. The V-groove of the sensor ensures correct positioning of the sensor on cylindrical objects.

To take readings, place the external sensor of the MiniTest 730 or 740 model and/or, with the built-in sensor, the complete gauge (MiniTest 720 or 740) onto the object to be measured. As soon as the sensor has been placed onto the object, a reading will be displayed.
In the “Single readings mode”, the reading will be stored into the active batch. Lift the sensor briefly and take the next reading.
In the „Scan mode“, readings are displayed continuously as long as the sensor is being placed on the object. To store the single reading being displayed into the active batch, press OK key.
Please avoid scratching the probe over the object to be measured in order to prevent wear-and-tear of the sensor pole.



5.4.2 High-precision stand

For taking readings on small objects and small geometries, it is recommended to use the external sensor in connection with the high-precision stand.

5.4.3 Duplex coatings systems

For measurement of zinced steel with additional surface finish, please use the dual sensors FN1.5 or FN5 sensors. With these sensors, you can determine the thickness of the zinc coating as follows:

1. Set the gauge to ferrous substrates and take reading. The total thickness of zinc plus surface finish will measured (thickness # 1)
2. Set the gauge to non-ferrous substrates. The zinc coating will be considered as non-ferrous substrate and the thickness of paint will be measured (thickness # 2)
3. Now you can evaluate the thickness of zinc coating by calculating the difference between the thickness #1 and thickness #2.

Please note that for measurement of duplex coating systems, a minimum zinc thickness of 40µm is prerequisite. For checking whether your zinc coating thickness is sufficient, please take zero value in the non-ferrous setting. Starting from a 40µm zinc thickness, the zero value is sufficiently good so that you can measure your duplex coating as described above.

5.5 Errors during measurement

After the sensor has been calibrated, you can proceed on taking readings in the measuring mode. Readings will be correct as long as the sensor specifications will be observed. Please refer also to section 6.1 Calibration „General remarks“ and Section 13 „Technical specifications“.

5.6 Measurement on hot surfaces (HT mode) with high-temperature sensors up to 350°C (HT-mode)

The measuring system MiniTest 7X0 (gauge with sensor) are designed for a maximum operating temperature of 60°C. Whilst the current operating temperature of the gauge depends on the ambient temperature of the air, the current operating temperature of the sensor is also influenced by the surface temperature of the object to be measured. This is due to the heat transfer taking place when the sensors comes into contact with the object to be measured.
Measurements on objects with surface temperatures higher than the specified sensor operating temperature are permissible with the special high-temperature sensors (such as item 80-173-5600 “F5 HT – 350°C”) if the following conditions are kept:

1. When taking readings, a measuring signal will sound approx. 1 second after placing the sensor onto the object to be measured in order to confirm acquisition of the reading. Make sure to lift the sensor immediately after the bleep sounds. This is to keep the heat transfer from the object to the sensor as low as possible. Do not keep the senor in contact with the measuring object for longer than one second.

2. Note that between two subsequent measurements on hot surfaces, a recovery time is required to cool down the sensor. Please refer to the table below for the temperature depending recovery times. If the below recovery times are respected, a virtually unlimited number of subsequent measurements can be taken.

3. If the sensor is in idle state, make sure not to place the sensor on hot surfaces to prevent heating up. Keep the sensor away from hot measuring objects to prevent heating up through heat radiation.

Sensor recovery times in HT mode

Temperature in °C	100°C	150°C	200°C	250°C	300°C	350°C
Recovery time in seconds	1 sec	2.5 sec	6 sec	12 sec	20 sec	30 sec

6. Calibration

6.1 General remarks

The MiniTest 700 series offers a number of calibration methods to meet the individual requirements of various applications, procedures and industrial standards. If a batch is being created you can select a suitable calibration method for this batch. The calibration can be carried out immediately after you have created a batch or at a later time in the measuring mode. To call up the calibration function in measure mode, press function key CAL. The calibration method can be changed as long as no readings are stored in the currently active batch.

A calibration is made in the currently active batch and is directly related to this batch.

To ensure an optimum calibration, the following points should be observed:

- Correct calibration is vital for accurate measurement. For calibration, a sample similar to the later object to be measured should be used, i.e. both, calibration sample and the object to be measured should be of the same shape and geometry. As a rule, you can say that the more similar the calibration sample and the later object to be measured are, the more accurate calibration and thus accuracy of readings will be.
- Make sure the calibration sample and the later object to be measured have same characteristics such as:
  - identical curvature radius of surface
  - identical substrate materials (such as magnetic permeability, electrical conductivity; in they ideal case, they should be made of the same material)
  - identical substrate thickness
  - identical size of measuring area
- Before starting calibration, make sure the calibration spot, the sensor tip and the calibration standard are clean. If necessary, remove any built-ups such as grease, metal chips, etc. Any impurities might affect calibration and lead to erratic calibration.
- Make sure the calibration position and the measuring position are always the same, this applies especially for measurement on small parts and measurements at edges and corners.
- Keep away from strong magnetic fields during the calibration procedure.
- For maximum accuracy of calibration and later measurements, choose the thickness of calibration standard within the same thickness range as the later measuring sample.

- For measuring thick non-ferrous metal coatings on steel or ferrous substrates according to the magnetic induction method (with F1.5, FN1.5, F5, FN5 or F15 sensors), a multi-point calibration must be carried out. The thickness standards must be of the same metal as the later object to be measured.
- If using calibration foils, make sure they are placed in plane position on the substrate material. Any air gap below the foils must be avoided as this would lead to erratic readings. If the foils are curved, make sure to place on them on the substrate as shown below.

The precision thickness standards must be handled with care. Any wear-and tear of the thickness standard will be reflected as erratic calibration value. Do not fold calibration foils. Any buckling will cause air gaps below the foil and result in erratic readings. Keep thickness standard clean, free from grease, oil, dust or other build-ups. Build-ups on the foils will be considered as thickness and will lead to a measuring error of the same value as thickness of build-up. To give you a rough idea: a build-up from a finger-print will be enough to add an additional thickness of some microns.

Please note:

If the gauge switches off during the calibration procedure due to low battery, the calibration procedure must be repeated after batteries inserting fresh batteries.

6.2 Calibration methods

According to your setting of task, you may use different calibration methods. Measuring accuracy depends on the selected calibration method. For more details please refer to section 13.2 Sensor Specifications.

6.2.1 Factory calibration

The status line shows “Factory“.

The factory calibration is used for quick and easy measurement with a medium accuracy (for more details please refer to section 13.2 Sensor Specifications). This calibration mode will be valid as long as you do not choose and/or activate another calibration mode.

6.2.2 Manual calibration method

6.2.2.1 Zero calibration

”Z” is shown in the status line
calibration point: zero point (directly on the substrate material)
Calibration is to be made on an uncoated calibration sample of the same geometry and material as the later measuring object. Only one calibration point is to be taken directly on the substrate to give you the zero point.
Zero calibration is for quick calibration if a medium accuracy is sufficient.

6.2.2.2 Two-point calibration

”Z 1” is shown in the status line
Calibration points: zero point (directly on the substrate material) and on the precision standard.

Calibration is to be made on an uncoated calibration sample of the same geometry and material as the later measuring object. Two calibration points are to be taken: one directly on the substrate to give you the zero point, the other one on a precision standard which is put on the substrate.

Compared to the zero calibration, this calibration method implies a higher accuracy. Accuracy will increase if the thickness of the precision standard is close to the thickness of the later object to be measured.

6.2.2.3 Multi-point calibration

“Z 12” is shown in the status line.
Calibration points: zero point (directly on the substrate material) and on two precision standards.

Calibration is to be made on an uncoated calibration sample of the same geometry and material as the later measuring object. Three calibration points are to be taken: one directly on the substrate to give you the zero point, and two further ones on two precision standards to be put on the substrate. It is recommended to choose a precision standard to cover the lower half of expected thickness range, the other one should be in the higher half of expected thickness range.

This calibration method should be used if readings are to be taken over an extended thickness range and if a high accuracy is required.

6.2.2.4 Two-point calibration without zero calibration

”12” is shown in the status line

calibration points: two precision standards (no zero point)

Calibration is to be made on an uncoated calibration sample of the same geometry and material as the later measuring object. Two calibration points are to be taken on two precision standards which are to be put on the substrate. The first precision standard should be thinner than the thickness to be expected, the other one should be thicker than the thickness to be expected. There is no zero point to be taken directly on the uncoated sample.

This specific calibration method should be used when taking readings on rough surfaces. Taking zero point on rough surfaces would imply strong deviations due to the uneven surface. That’s why zero point is omitted in this calibration method as this would lead to erratic calibration and thus affect accuracy.

6.2.3 Defined, menu-guided calibration methods

6.2.3.1 General remarks

For all defined and menu-guided calibration methods the following applies:

The selection of a defined calibration method is made during the creation of a batch. After you have completed the set-up of a batch, you may proceed on the menu-guided calibration. The factory calibration will be valid until you have completed the calibration procedure. A running calibration procedure is indicated by CAL flashing in the status line.

6.2.3.2 Calibration according to ISO (EN ISO 19840)

“ISO” is shown in the status line.

Calibration points: zero point (directly on the substrate material) and on two precision standards.

This standard does not apply if the target thickness is less than 40 microns.

Calibration is made on the uncoated calibration sample of the same geometry and substrate material as the later object to be measured. Three calibration points are to be taken: zero point (directly on the substrate) and two further one on two precision standards which are to be put on the substrate. The first precision standard should be thinner than the thickness to be expected, the other one should be thicker than the thickness to be expected.

To compensate for roughness, a correction value related to the actual roughness of sample must be used according to the table below. As an alternative, a specific correction value can be determined according to Method A (see section 6.3.2) and set accordingly.

If the roughness value is not known and no uncoated sample is available, the correction value “25 microns” should be used.
It is recommended to take sufficient readings according to the size of measuring area. A minimum number of 5 readings should be taken.
The block statistics defines a number of 5 readings per block. If required, e. g for larger surfaces, you can increase the number of readings per block accordingly.

Roughness profile according to ISO 8503-1	Correction value (roughness) microns
fine	10
medium	25
coarse	40

6.2.3.3 Calibration method „rough“

“RGH” is shown in the status line.
Calibration points: on two precision standards (no zero point)
This calibration method is used for rough surfaces such as on blasted samples.
Two calibration points are to be taken on two precision standards which are to be put on the substrate. The first precision standard should be thinner than the thickness to be expected, the other one should be thicker than the thickness to be expected. There is no zero point to be taken directly on the uncoated sample.

To achieve a maximum adaptation to the surface roughness of sample, you may use several precision standards (50 µm max. thickness each) to lay them on top of each other. Thin precision standards are more flexible than the thick ones and thus better adapt to uneven surfaces.
Take at least 5 to 10 readings to calculate the average thickness.

6.2.3.4 Calibration method “Swedish” (SS 18 41 60)

“SWD” is shown in the status line.
Calibration points: on two precision standards (no zero point)

Two calibration points are to be taken on two precision standards which are to be put on the substrate. The first precision standard should be thinner than the thickness to be expected, the other one should be thicker than the thickness to be expected. There is no zero point to be taken directly on the uncoated sample.

The block statistics defines a number of 5 readings per block.

6.2.3.5 Calibration method “Australian”

“AUS” is shown in the status line.
Calibration points: zero point (directly on the substrate) and on one precision standard.

Two calibration points are to be taken: one directly on the substrate (zero point) and another one on a precision standard. The precision standard should be in the thickness range of the later object to be measured.

The block statistics is defined for a minimum of 3 readings per block.

- If coating thickness is less than threefold the value of roughness profile height, the roughness of the substrate material must be taken into consideration.
- If the uncoated rough substrate can be accessed, a two-point calibration as described under section 6.4.3.3 should be made on the uncoated, smooth (non blasted) and clean calibration sample of the same geometry and material as the later measuring object.
  After this, at least 10 readings should be taken on the rough (non blasted) and uncoated measuring object. Enter the roughness mean value $\overline{x}$ as roughness value in the setting “1/3 profile height“ of the current batch. The roughness value you have entered will be subtracted automatically from the thickness reading to give you the coating thickness over the peaks.
- If there is no access to the uncoated rough substrate, the parameter “1/3 profile height” must be set to 1/3 of the expected profile height. Example: 60 microns => Value to be set for “1/3 profile height” 20 microns.

6.2.3.6 Calibration according to SSPC-PA2

“SSPC” is shown in the status line.

This method applies for rough substrates such as blasted or grinded samples.

Case 1: The sample to be measured is completely coated (no access to the blank substrate)

- Calibration points: zero point (directly on the substrate of a calibration object) and two further ones on two precision standards.

  Calibration is made on the uncoated, smooth sample. The sample should have the same geometry and substrate material as the later object to be measured (please refer to section 6.2.2.3 Multi-point calibration).

  The block statistics defines a number of 3 readings per block.

  To compensate for roughness, a correction value according to the table below must be used. As an alternative, a specific correction value can be determined and set accordingly. If the roughness value is not known and no uncoated sample is available, a correction value “25 microns” should be used.

- A suitable number of readings should be taken according to the size of area to be measured.

  The block statistics defines a number of 3 readings per block.

Roughness profile according to ISO 8503-1	**Correction value (roughness) microns**
fine	10
medium	25
coarse	40

Case 2: The sample is not coated completely (the substrate can be accessed)

- A calibration according to section 6.3.4 \ Method C or according to the predefined calibration method “Rough” is to be carried out. During the creation of a batch select “Manual” our “Rough”. Set the block statistics to 3 reading per block.

6.3 Blasted and rough surfaces

6.3.1 General remarks

To remove rust in order to ensure a good adhesion of the paint, surfaces are commonly blasted in pre-treatment. As a result, the base material gets rough. Roughness influences the measuring results, i.e. readings will be higher than the actual thickness.

The following section describes some steps how to remove the influence of roughness in coating thickness measurement.

For calibration and for determining the average, it is generally recommended to take at least a set of 10 readings.

If you proceed on thickness measurement according to the steps below, the average thickness over the peaks will be displayed. Note that the statistics program is of great benefit in this procedure.

6.3.2 Method A (Roughness Rz > 20µm)

When creating the batch, adjust calibration method to “Manual“.

Calibration points: zero point and on one precision standard.

- Carry out a two point-calibration according to section 6.4.3.2. Use a smooth (non blasted) and clean calibration sample with the same geometry and the same substrate as the later measuring sample.
- Take approx. 10 readings on the uncoated, rough (blasted) sample to produce the mean value. Enter this value as roughness value in the “Roughness” setting of batch.

The roughness value you have entered will be automatically subtracted from the thickness value to give you the thickness value over the peaks. Take a set of at least 10 readings on the coated and rough (blasted) sample.

6.3.3 Method B (Roughness Rz < 20µm)

When creating the batch, adjust calibration method to „Manual“.

Calibration points: zero point and on a precision standard.

- Carry out a two point-calibration according to section 6.4 3.3. Use an uncoated, rough (blasted) and clean calibration sample with the same geometry and the same substrate material as the later measuring sample.
- Take at least 10 readings on the uncoated calibration sample followed by 10 readings on the precision standard. To ensure an optimum adaptation to the surface roughness you may use several precision standards (of max. 50 µm thickness each) and lay them on top of each other. The thin precision standards are more flexible than the thick ones to adapt better to the surface roughness. The calibration value should roughly correspond to the coating thickness to be expected.

For thickness measurement, the average thickness is calculated from a set of 5 to 10 individual readings.

6.3.4 Method C

- Calibration using two different precision standards. Also this method provides reliable results. It is the two-point calibration without zero point according to section 6.4.

- To achieve a maximum adaptation to the surface roughness of sample, you may use several precision standards (50 µm max. thickness each) to lay them on top of each other. Thin precision standards are more flexible than the thick ones and thus better adapt to uneven surfaces.
- Take at least 5 to 10 readings to calculate the average thickness.

Please note: With coatings thicker than 300 µm, the influence of roughness can be neglected. That's why for this coatings, the above calibration methods can be omitted here.

6.4 How to calibrate

6.4.1 General remarks

For all calibration methods applies:

- The required calibration method is to be selected while you create a batch. Please refer to section 7.2.2.

For all calibration methods except for the factory calibration applies:

- For optimum calibration accuracy it is recommended to take several readings for each calibration point. The gauge automatically calculates the average in order to reduce the variations and erratic readings to a minimum.
- Calibration may be effected in both, in the "single reading" mode or in the "scan" mode.
- Once readings are stored in a batch, you cannot change the calibration method that has been used for taking readings in this batch.

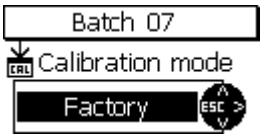
If you refresh Zero, the existing calibration values will become invalid!

However you can recalibrate in the adjusted calibration method.

For a new zero calibration, you have to run through the complete list of calibration points.

For the other calibration points, they may be recalibrated individually by means of the precision standards.

6.4.2 Factory calibration (STD)

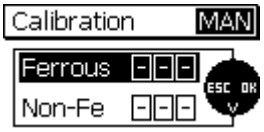


If the factory calibration is active, you may immediately proceed on measurement after the batch creation has been completed.

6.4.3 Manual calibration

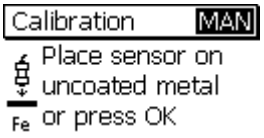
In measure mode, press function key CAL to call the calibration mode.

6.4.3.1 Calibrating FN sensors

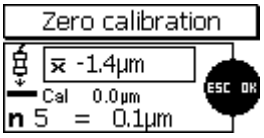


If a the measuring method “Auto-F/N” has been defined for a batch you may calibrate for both, the ferrous and the non-ferrous base. In this case, the calibration procedure will be performed twice. You will automatically be asked to select the first base for which you wish to calibrate. Use arrow up and down keys to make your selection and press OK to confirm. After the calibration for your selected base has been completed, you will be asked to choose the next one. Use arrow up/down keys to make your selection and press OK to confirm. Perform calibration accordingly. After this you will be asked again to select a base. If calibration for both bases has been completed, you can quit calibration by pressing “ESC”. You will go back to the measure mode.

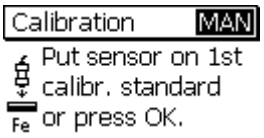
6.4.3.2 Zero point calibration



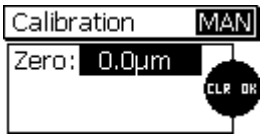
Start calibration and put the sensor on the blank/uncoated calibration sample. Wait for the signal to sound and lift sensor. Please observe the instructions in section 6.1 General.



Repeat this procedure several times (approx. 3 to 10 times) on the same measuring spot. The average $\bar{x}$ will be shown. Evaluation of average is to increase accuracy of calibration. Accuracy will increase with an increasing number of readings. Press OK to confirm zero calibration. Press OK once again to complete the calibration procedure.

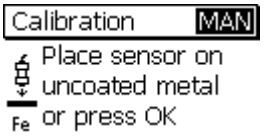


You will be asked to calibrate on the first precision standard. Press OK to jump this step.

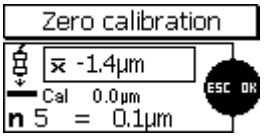


A list will appear to show you the points that have been calibrated. Press OK to go back to the measure mode. In the Auto F/N calibration you will go back to the base selection.

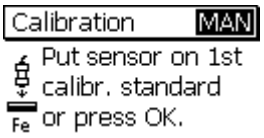
6.4.3.3 Two-point calibration



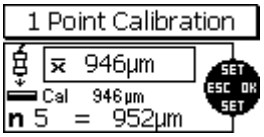
Start calibration and put the sensor on the blank/uncoated calibration sample. Wait for the signal to sound and lift sensor. Please observe the instructions in section 6.1 General.



Repeat this procedure several times (approx. 3 to 10 times) on the same measuring spot. The average $\bar{x}$ will be shown. Evaluation of average is to increase accuracy of calibration. Accuracy will increase with an increasing number of readings. Press OK to confirm zero calibration. Press OK once again to complete the calibration procedure.

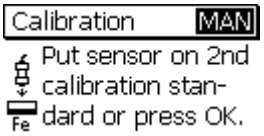


Put a precision standard on the uncoated calibration sample. Place the sensor on top of it, wait for the signal to sound and lift sensor. Repeat this procedure several times (approx. 3 to 10 times) on the same measuring spot. The average $\bar{x}$ will be shown.

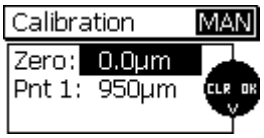


If the set point (Cal) as displayed is not identical with the thickness of your precision standard, use arrow up and down keys to adjust accordingly.

Press OK to store the calibration point. Press OK once again to complete the calibration procedure.

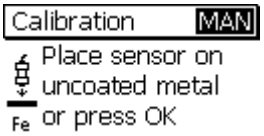


You will be asked to calibrate on the second precision standard. Press OK to jump this step.

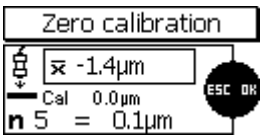


A list will appear to show you the points that have been calibrated. Press OK to go back to the measure mode. In the Auto F/N calibration you will go back to the base selection routine.

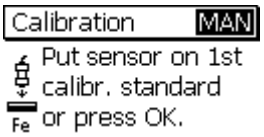
6.4.3.4 Multi-point calibration



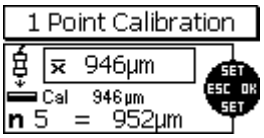
Start calibration and put the sensor on the blank or uncoated calibration sample. Wait for the signal to sound and lift sensor.



Repeat this procedure several times (approx. 3 to 10 times) on the same measuring spot. The average $\bar{x}$ will be shown. Evaluation of average is to increase accuracy of calibration. Accuracy will increase with an increasing number of readings. Press OK to confirm the calibration point. Press OK once again to complete the calibration procedure.

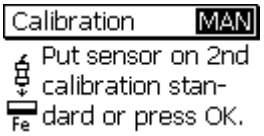


Put the first precision standard on the uncoated calibration sample. Place the sensor on top of it, wait for the signal to sound and lift sensor. Repeat this procedure several times (approx. 3 to 10 times) on the same measuring spot. The average $\bar{x}$ will be shown.

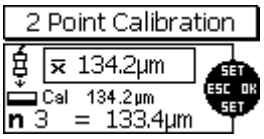


If the shown set point (Cal) as displayed is not identical with the thickness of your precision standard, use arrow up and down keys to adjust accordingly.

Press OK to confirm the calibration point.

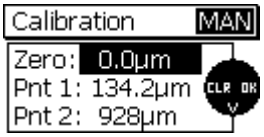


Put the second precision standard on the uncoated calibration sample. Place the sensor on top of it, wait for the signal to sound and lift sensor. Repeat this procedure several times (approx. 3 to 10 times) on the same measuring spot. The average $\bar{x}$ will be shown.



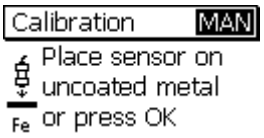
If the shown set point (Cal) as displayed is not identical with the thickness of your precision standard, use arrow up and down keys to adjust accordingly.

Press OK to confirm the calibration point.

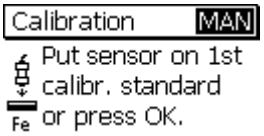


A list will appear to show you the points that have been calibrated. Press OK to go back to the measure mode. In the Auto F/N calibration you will go back to the base selection routine.

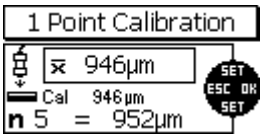
6.4.3.5 Two-point calibration without zero point



Start calibration. Press OK to jump zero point calibration.

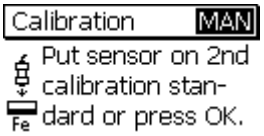


Put the first precision standard on the uncoated calibration sample. Place the sensor on top of it, wait for the signal to sound and lift sensor. Repeat this procedure several times (approx. 3 to 10 times) on the same measuring spot. The average $\bar{x}$ will be shown. Evaluation of average is to increase accuracy of calibration. Accuracy will increase with an increasing number of readings.

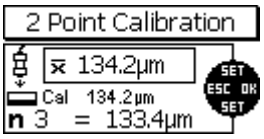


If the shown set point (Cal) as displayed is not identical with the thickness of your precision standard, use arrow up and down keys to adjust accordingly.

Press OK to confirm the calibration point.

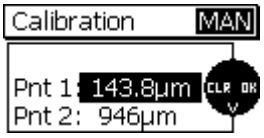


Put the second precision standard on the uncoated calibration sample. Place the sensor on top of it, wait for the signal to sound and lift sensor. Repeat this procedure several times (approx. 3 to 10 times) on the same measuring spot. The average $\bar{x}$ will be shown.



If the shown set point (Cal) as displayed is not identical with the thickness of your precision standard, use arrow up and down keys to adjust accordingly.

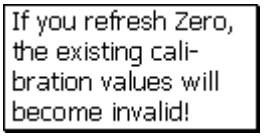
Press OK to confirm the calibration point.



A list will appear to show you the points that have been calibrated. Press OK to go back to the measure mode. In the Auto F/N calibration you will go back to the base selection routine.

6.5 How to recalibrate

If measuring conditions have changed, it may become necessary to recalibrate without changing the calibration method. This can be done at any time, even if readings are stored in the relevant batch (Please note that it is NOT possible to change the calibration mode of an existing batch with stored readings).



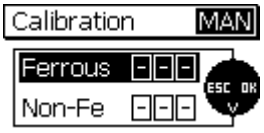
If you have put the sensor on the uncoated sample the message as shown on the left will appear. If during recalibration you refresh zero, you have to repeat all subsequent calibration points.

Press OK to confirm and go through the calibration procedure as usual.

If you do not refresh the zero point and jump this point, the alert message as shown on the left will be omitted. Only the recalibrated points will be replaced.

6.6 Interrupt or abort a calibration procedure

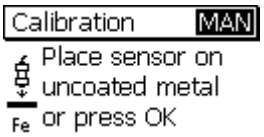
Press ESC to interrupt or abort a calibration procedure. According to the situation, the following reactions may occur:



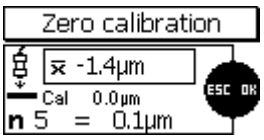
Situation 1:

If a calibration value has not yet been taken:

If you press ESC you will go back to measure mode. The previous

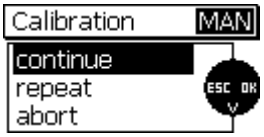


calibration will remain active.



Situation 2:

If you have taken at least one calibration value for any calibration point but the calibration procedure for this point has not been completed, i.e. you have not pressed OK to confirm:



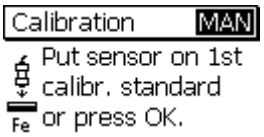
If you press ESC you can select from the following list:

Continue: You will continue calibration, all calibration points and values you have taken so far will remain valid.

Repeat: The calibration values you have taken for the previous calibration point will be deleted. You can continue the calibration procedure for the previous calibration point.

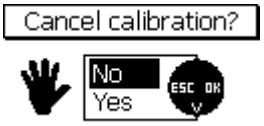
Cancel: All calibration points and values will be deleted. The previous calibration will become valid.

Use arrow up or down keys to select your preference from the list. Press OK to confirm.



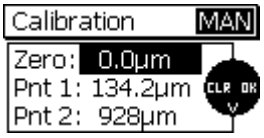
Situation 3:

If you have completed at least one calibration point and you have confirmed by pressing OK or if you have jumped one calibration point but the calibration procedure has not yet been completed, i.e. if you may take some more calibration points:

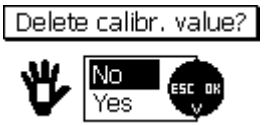


If you press ESC, you will be asked whether to cancel calibration or not. Use arrow up or down keys to make your selection. Press OK to confirm. If you choose “No”, the calibration procedure will be continued. If you choose “Yes”, the calibration procedure will be completed at this step and all calibration points you have taken so far will be stored. This will be the same effect as pressing OK once again after a calibration point has been taken.

6.7 Delete a calibration point



After a calibration procedure has been completed, you may delete individual calibration points or delete the whole calibration.



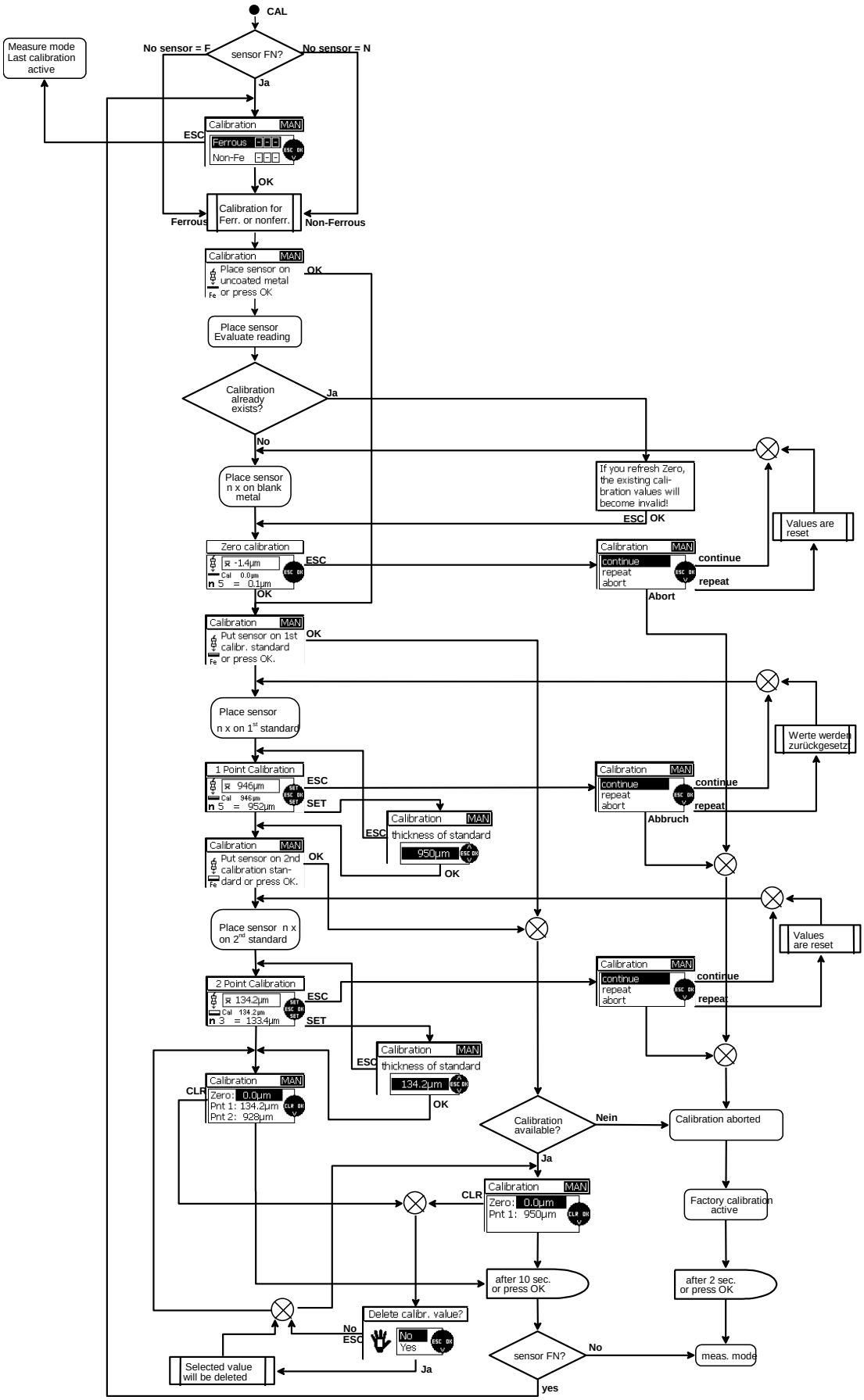
Use arrow up and down keys to select the calibration point to be deleted. Press ESC to delete. For safety reasons, the checkback as shown on the left will appear. If you select YES, the calibration value you have selected will be deleted.

After deletion, the remaining calibration points will be renumerated. If, e.g. in a multi-point calibration, you delete point 1, the former point 2 will change to point 1.

If you delete the zero calibration point, the complete calibration will be deleted.

Note: Readings stored in a batch will remain valid even if you delete all or only some of the calibration points.

6.8 Calibration – Quick reference



7. Data Management

7.1 Batches

7.1.1 General remarks

With all models of the MiniTest 700 series, readings, calibrations, statistics and parameters are stored as a set of data into a batch, i.e. apart from the readings, a batch includes its individual calibration, setting parameters and statistics. If you open an existing batch, the calibration and parameters stored in this batch will become active.

Go to the main menu and select “Data base” to view all batches. The batch names (BATCHxx) are predefined.

- The MiniTest 720 model features 10 batches.
- The MiniTest 730 model features 10 batches.
- The MiniTest 740 model features 100 batches.

If you are in measure mode, the currently active batch is shown in the status line (upper display line). It is referred to as „BATCHxx“. xx = is the current number of batch.

7.1.2 Memory Size

The memory of the MiniTest 720 and 730 models are designed to store a total of 10,000 readings. The MiniTest 740 model can store up to 100,000 readings.

With all models, the memory can be divided into batches according to customer requirements. So you can use for instance the complete memory for one single batch only. The space of a batch will be assigned automatically according to your requirements, i.e. you do not have to predefine the size of a batch.

7.1.3 Parameters

All measuring series include the following parameters: “Calibration method”, “Substrate”, “Measure mode”, “Roughness” (1/3 profile depth with “Australian” calibration method”), “Offset”, “Block size”, “Upper limit” and “Lower limit”.

It may occur that not all parameters are available, this depends on the calibration method you have selected (see table of parameters).

If you call an existing batch, the parameters and calibration related to this batch will be activated.

As a rule, each batch is related to the sensor that has been used while creating this batch. This is of no importance to the MiniTest 720 and 730 as these models feature a fixed probe.

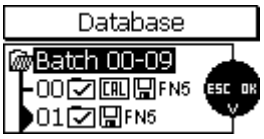
With the MiniTest 740, however, make sure to use the correct sensor when calling a batch, otherwise an alert message will appear and you will not be able to make changes in this batch nor to take any readings.

Table of parameters

Calibration methode Parameter	Factory calibration	ISO	SSPC	Rough	Australian	Swedish	Manual
Measure mode	x	x	x	x	x	x	x
Roughness	-	x	x	-	-	x	x
Profile depth	-	-	-	-	x	-	-
Offset	-	x	x	x	x	x	x
Block size	-	**5-100**	**3-100**	**1-100**	**3-100**	**5-100**	**1-100**
Upper limit	x	x	x	x	x	x	x
Lower limit	x	x	x	x	x	x	x
Symbol shown in status line	**STD**	**ISO**	**SSPC**	**RGH**	**AUS**	**SWD**	**MAN**
Auto-FN mode	x	-	-	-	-	-	x

7.2 Data base

7.2.1 General remarks

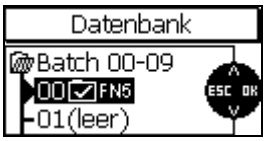


The data base is for management of your batches. You can create new batches, define their calibration methods and parameters as requested or open existing batches to start a measuring series. With the MiniTest 720 and 730 models (featuring 10 batches), all batches are listed in one single list.

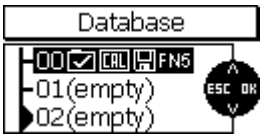
With the MiniTest 740 (100 batches), the batches are subdivided into 10 groups each to enable quicker access.

7.2.2 Create a new batch

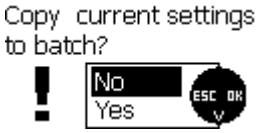
Press function key MENU to call the main menu. Press OK to confirm the preselected menu point “data base”.



Please note: At initial switch on or after a total reset, the batch # 00 with a preset factory calibration becomes active. It is related to the sensor connected (e.g. FN5). With the MiniTest 740 model, this batch always relates to currently connected sensor. Now you can directly proceed on measurement.



Use arrow up/down keys to select an “empty” batch. Press OK to confirm. The selected batch will open.



You will be asked whether to copy the currently active settings (parameters and calibration) into the new batch. Choose “No” if you wish to make your own settings. Press “Yes” if you wish to copy the settings into the new file. The copy settings function is very convenient if you wish to create several batches of the same kind.

If you wish to make new parameter settings, the parameter settings routine will be called. Now you can view and change all parameters one after the other.

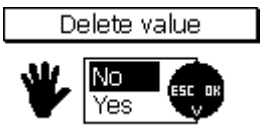
Press OK to go from one parameter to the next one.

User arrow up/down keys to change the parameter settings as requested.

Press ESC to go back to the previous parameter.

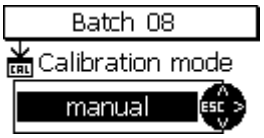
To quit the parameter settings routine, you can press ESC if the first parameter is called (calibration method) or press OK if you are in the parameter view.

When setting numerical parameters such as “Offset”, “Upper limit” and “Lower limit”, the ESC key assumes two functions: if there is no value attached to a numerical parameter (this is shown by horizontal bars), you can press ESC to go back to the previous parameter.



If, however, a value has already been attached, pressing ESC will call a submenu. In this submenu you can delete the value attached to this parameter. Select “Yes” in the submenu to proceed on deletion. Then press OK to confirm. Horizontal bars will show successful deletion of the parameter.

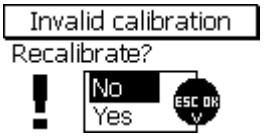
If you select “No” followed by OK or ESC you will go back to the previous parameter.



Parameter “Calibration mode”

You can select from the following list:

- Factory
- Manual
- ISO
- SSPC
- Rough
- Australian
- Swedish



With all predefined calibration methods (except for “Factory” and “Manual”) the following message will appear once you have run through the batch creation procedure: “Invalid calibration – recalibrate?”. At this point you can decide whether to recalibrate immediately or at a later point in measure mode.

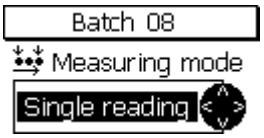
Parameter “Substrate” (with FN sensors only)

When using the FN sensor, you can define a suitable substrate. The following options are available:

Ferrous: magnetic induction principle for ferromagnetic substrates (ferrous substrates, steel, alloy steel)

Non-ferrous: eddy currents principle for nonmagnetic, conducting substrates (nonferrous substrates, austenitic steel)

Auto F/N: the probe automatically identifies the substrate and selects the matching measuring principle (this option is only possible with the “Factory” or “Manual” calibration method.)

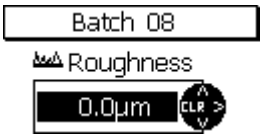


Parameter “Measuring mode”

Available options: “single reading” and “Scan mode”.

In the “single readings” mode, a reading is taken and stored into the batch each time you put the sensor onto the sample, i.e. put the sensor on the sample to take a reading, lift the sensor and put the sensor down again to take the next one.

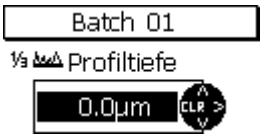
In the “Scan mode”, readings are taken and displayed continuously as soon as you put the sensor on the sample. Lift the sensor to stop taking readings. Press OK to store the latest single reading to the batch.



Parameter “Roughness”

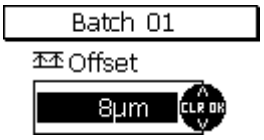
To compensate for roughness, you can enter a correction value “roughness” as related to the current roughness value of your substrate.

This is not possible in the “Factory” calibration setting.



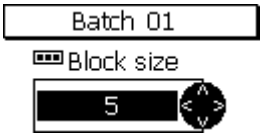
Parameter “1/3 profile height”

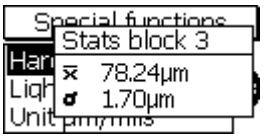
To compensate for roughness, you can enter a correction value “roughness” as related to the current roughness value of your substrate. This only applies to the calibration method “Australian”.



Parameter “Offset”

With the offset-function you can automatically add or subtract a constant value to / from the reading so that deviations from a target value can be quickly identified and documented.

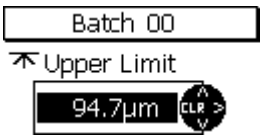


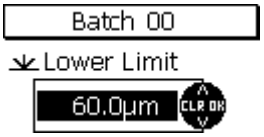


Parameter “Block size”

Subsequent readings of a batch can be divided into blocks, each of the same size (block grouping of readings). The number of readings per block can be adjusted from 1 to 100. A statistics will be created for each block. The norm-compliant modes “ISO”, “SSPC”, “Swedish” and “Australian”, require block grouping of readings and block statistics. In some of these norms the block size is predefined.

For the single readings statistics, the block size must be adjusted to “1”.





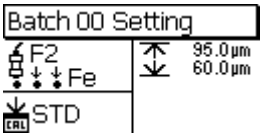
Parameter: Upper limit / Lower limit

You can set upper and lower limits to monitor deviations from the set point. Readings beyond the specified limits will be signalled through the LED lighting up in red (key above the MENU function key). In addition , a signal tone will sound. Readings beyond the tolerance limits will be marked on the list of single readings.

Tolerance limits can be set at any time before, during or after acquisition of readings.

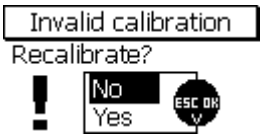
The parameters “calibration method”, “substrate”, “offset” and “block size” can only be changed as long as there are no readings stored in your batch. As soon as there are readings stored in the batch, a lock symbol will appear on screen to indicate that the requested parameter cannot be changed.

If you still wish to have these parameters changed, (e. g for using this measuring series for a new application), you first have to delete the readings of this batch (see section 7.2.6).



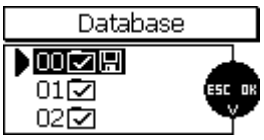
To complete the batch setting procedure, an overview of your parameter settings appears on screen.

For your quick reference, this overview can also be selected via the main menu. Select “data base” followed by “overview” (see section 7.2.5).



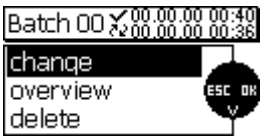
With all predefined calibration methods with the exception of “factory” and “manual”, the following message will appear after the batch settings procedure: “Invalid calibration – Recalibrate ?”. At this point you can decide whether recalibration should be made now or later during measurement.

7.2.3 Select a batch for taking readings



Press function key MENU and select “Database”. Press OK to confirm. The currently active batch is marked by an arrow.

Use up/down arrow keys to select the requested batch. Press OK to confirm.



Your selected batch is now active. The display shows name of batch, date and time of batch setting and the last modification. You can select from the following options: change, overview, delete.

If there are no parameter changes are to be made, you can directly proceed on measurement. Place the sensor onto the measuring object. The gauge changes to measuring mode and the reading you have taken is being displayed.

7.2.4 Change a batch

Press function key MENU and select “Database”. Press OK to confirm. The currently active batch is marked by an arrow.

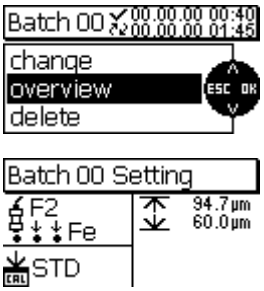
Use up/down arrow keys to select the requested batch. Press OK to confirm. Select “change” and press OK to confirm. The parameter setting procedure will be launched (see section 7.2.2). You can view the

list of parameters and change their settings as required.

The parameters “calibration method”, “substrate”, “offset” and “block size” can only be changed as long as there are no readings stored in your batch. As soon as there are readings stored in the batch, a lock symbol will appear on screen to indicate that the requested parameter cannot be changed.

If you still wish to have this parameter changed, (e. g for using this measuring series for a new application), you first have to delete the readings of this batch (see section 7.2.6).

7.2.5 Parameter Overview



Press function key MENU and select “Database”. Press OK to confirm.

Use up/down arrow keys to select the requested batch. Press OK to confirm. Use arrow up/down keys to select “overview” and press OK to confirm.

Display will show the parameter settings of the active batch.

Parameters – List of symbols and their meanings

FN5	Sensor type (FN 1.5, F 1.5, N07, FN5 , F5, N2,5, F2, F15)
Auto Fe N-Fe	Measuring principle („Auto (Auto-F/N), „Fe (Ferrous)“, N-Fe (Non-Ferrous))
	Measuring mode „Single reading”
	Measuring mode „Scan mode”
STD	Calibration method „Factory“
MAN	Calibration method „Manual”“
ISO	Calibration method „ISO“
SWD	Calibration method „Swedish”
AUS	Calibration method „Australian”
SSPC	Calibration method „SSPC“
RGH	Calibration method „Rough”
10.0µm	⅓ profile depth or ⅓ profile depth = 10 µm
25.0µm	Offset = 25 µm
120.0µm	Upper limit = 120,0 µm
80.0µm	Lower limit = 80,0 µm
5	Block size = 5, block statistics being active (block size > 1).
✓	Parameter settings of the selected batch
	Date and time of last modification of the selected batch

7.2.6 Delete a batch

Press function key MENU and select “Database”. Press OK to confirm. Use up/down arrow keys to select the requested batch. Press OK to confirm. Select “delete” and press OK to confirm.

The message “Delete all ?” will appear. If you press YES, the batch you have selected will be deleted and the message “Readings and settings have been deleted” confirms deletion.

Attention !

Once you have deleted the readings and settings of a batch, they cannot be restored.

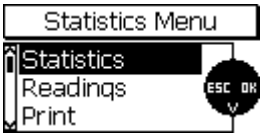
8. Statistics / Statistical Evaluation

8.1 General remarks

From measuring mode, press function key STAT to access the statistics menu. In this menu you can view, print-out and delete statistical and single values or transfer them to a PC. For more details on statistical terms please refer to section 14.2.

8.2 View statistics

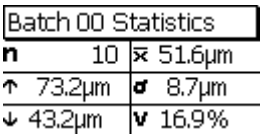
8.2.1 View statistics with disabled block option



The statistics refers to the whole batch. If the group into blocks option has been disabled (block size: 1), statistics will be calculated from single readings (Single readings statistics).

If you press function key STAT from measuring mode, the statistics menu will be called. Press OK confirm.

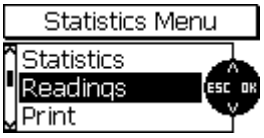
As an alternative, you can call this function form the measuring mode by pressing function key STAT twice.



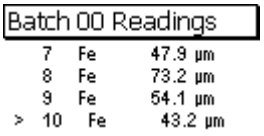
The batch statistics include the following values:

n = number or readings	$\bar{x}$ = mean value
$\overline{x}$ = Maximum	**σ** = standard deviation
$\underline{x}$ = Minimum	**v** = variation coefficient in pc (%)

8.2.2 View single readings



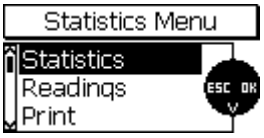
Press function key STAT from measuring mode to call the statistics menu. Use arrow up/down keys to select “Readings” and press OK to confirm.
The list of single readings appears.
As an alternative, you can call this function form the measuring mode by pressing function key STAT three times.



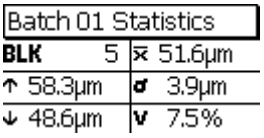
Use arrow up/down keys to scroll through the list of single readings of your batch. The list shows the serially numbered readings along with the measuring principle that has been used for acquisition of the reading. If you have set tolerance limits, readings off tolerance will be marked accordingly (> above limit; < below limit).

Readings that have been deleted will be marked by an “X”. Deleted readings will not be included in the print-out, neither will they be transferred or used for statistics calculation.

8.2.3 View statistics if readings are grouped into blocks



These statistics refer to the whole batch. If readings are grouped into blocks (blocks size > 1), the batch statistics will be calculated from the results of the different block statistics.
Press function key STAT from measuring mode to call the statistics menu. Select “Statistics” and press OK to confirm.
As an alternative, you can call this function from the measuring mode by pressing function key STAT twice.



The block value statistics includes the following values:

BLK= number of completed blocks

↑= Maximum

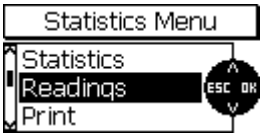
↓= Minimum

$\bar{x}$= mean value

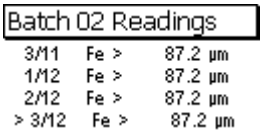
σ= standard deviation

v= variation coefficient in pc (%)

8.2.4 View single readings and block statistics



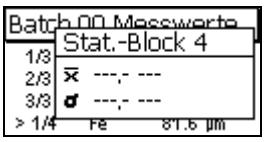
The group readings into blocks (block size >1) option has been enabled, press function key STAT to call the statistics menu. Use arrow up/down keys to select “Readings” and press OK to confirm.
As an alternative, you can call the list of readings from the measuring mode by pressing function key STAT three times.



Use arrow up/down keys to scroll through the batch. The readings are serially numbered (first figure on the left) and displayed along with the block number (second figure after the slash) and the measuring principle used for taking the reading.

If you have set tolerance limits, readings off tolerance will be marked accordingly (> above limit; < below limit).

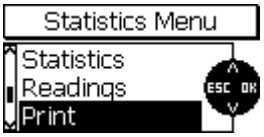
Readings that have been deleted will be marked by an “X”. Deleted readings will not be included in the print-out, neither will they be transferred or used for statistics calculation.



Block statistics cannot be shown until a block has been completed.

8.3 Statistical values / Print-out and data transfer to a PC

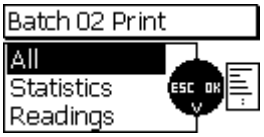
All models of the MiniTest 700 series are equipped with an infrared port (IrDA 1.0). Readings and statistics of a batch can be transferred to a PC or printed out on the MiniPrint 7000 data printer.



Press function key STAT to call the statistics menu.

Use arrow up/down keys to select “Print”.

Press OK to confirm.



In the Print menu you have the following options to specify the range of data to be transferred to a PC or to be printed-out:

- „All“ : statistics and readings
- „Statistics“ : statistical values only
- „Readings“ : single readings only

Use arrow up/down keys to make your selection.

Press OK to confirm.

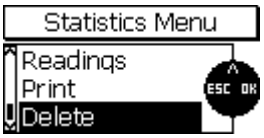
After the printing function has been activated, the message „Connecting ...“ appears.

Once the data transfer is in progress, the message “Transmitting data…” appears.

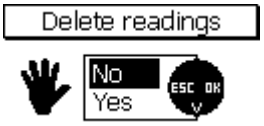
If no infrared connection to a printer or PC can be established, the message “No PC or printer found” appears. If the message “Data transfer error !” appears, please proceed as follows:

- Check the configuration of your PC and/or printer
- Make sure there are no obstacles between the IR devices so that the IR connection can be established.
- If necessary, use a soft and moist cloth to clean the IR devices. Please use water or a soft detergent for cleaning.

8.4 Delete readings of a batch



Press function key STAT to call the statistics menu.
Use arrow up/down keys to select “Delete”.
Press OK to confirm.



You will be requested to confirm deletion.
If you press YES, all readings of the currently selected batch will be deleted.
Once the deletion has been completed, the message “Readings deleted” will appear.

Attention !
Readings will be irrevocably deleted and cannot be restored.

8.5 Delete a current reading

In the single readings mode, a reading shown on display can be deleted immediately after its acquisition by pressing ESC
A deleted reading will continue to be shown on the single readings list but will be marked with an “X”. However, a deleted reading will not be used for statistics calculation, neither will it be printed out or transferred to a PC.
In the Scan mode, it’s not possible to delete a reading once it has been stored into the statistics memory.

9. Main menu

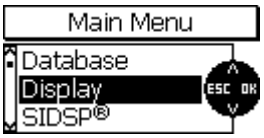
9.1 General remarks

The Main menu represents the highest level in the menu structure. From the Main menu you can access the various submenus such as the settings menu, data base and gauge specifications.
Press function key MENU to access the Main menu. Use arrow up/down keys to select the requested submenu. Press OK to confirm.
The last two submenus on the list „Sensor data“ and „Gauge data“ only include information to be viewed. You cannot make any changes in this menu.
In all other submenus, changes can be made.

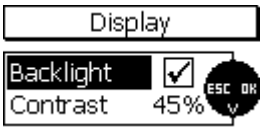
9.2 Data base

Please refer to section 7.2

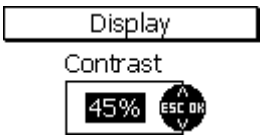
9.3 Display



In this menu you can enable/disable the display backlight and set the contrast (in percent).



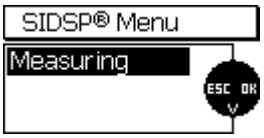
Press OK to enable (ticked box) or disable the backlight. Please note that power consumption will be higher with this mode enabled and the battery life will be reduced accordingly. If batteries are low, the backlight option cannot be enabled.



Select „Contrast“ and press OK to confirm. Now use arrow up/down keys to adjust contrast in percent as required (from 30 to 90%). Press OK to confirm your setting.
Press ESC to quit this menu.

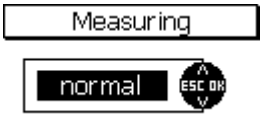
9.4 SIDSP®

In the SIDSP® menu you can make changes to the measuring mode (normal, fast, high precision).



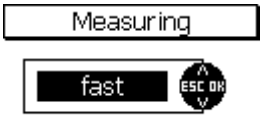
Measuring

This parameter can be set to define the sensor characteristics during acquisition of readings. According to your setting, you can optimize the acquisition of readings such as measuring speed or precision. Select “Measuring” and press OK to confirm.



Normal:

This is the setting for measuring at a medium speed and a medium precision.



Fast:

This setting is for increased measuring speed and is recommended for taking quick readings on large surfaces.

High precision:

This setting is for measuring at a maximum precision. Please note that the measuring speed has no priority in this setting.

If you select “high precision” it is recommended to use the precision stand to ensure that readings are always take at the same spot.

Please select “normal” if you do not use the measuring stand.

9.5 Time / Date

The gauge features a quartz-controlled time clock to indicate date and time. The current time is shown top right in the status line (visible in measuring mode only). The time clock is also used for fixing date and time of creation / last modification of a batch. Date and time of creation/ last modification will also be stored and indicated with a batch and displayed while opening this batch.

In data transfer to the data printer or a PC, the date and time of data transfer and date and time of last modification of a batch will also be transferred.

Select „Time/ Date“ to set day, month, year and time.

You can also fix a format of date and time.

9.6 Language

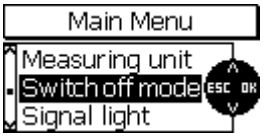
This menu item is for setting your requested language. If you have accidentally set a wrong language, the flag symbol will help you to quickly retrieve this menu item.

Use arrow up/down keys to select “Languages”. Press OK to confirm. The currently set language will be displayed in the language as set. Press OK to confirm or use arrow up/down keys to make your selection. Press OK to confirm or quit without changing the language by pressing ESC.

9.7 Measuring unit

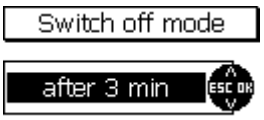
This menu item is for setting the measuring system. You can select metric system (“µm“, “mm“, “cm“) or imperial (“mils”, “inch” and “thou”). The measuring units within a measuring system will be automatically set by the gauge according to the thickness being taken.

9.8 Switch off mode

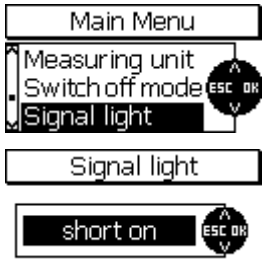


The gauge features a switch-off mode to save battery life. In this mode, the gauge will switch off after the time interval you have fixed if the gauge has been idle for a while.

The time interval can be set to 1, 3, 10 or 30 minutes. If you do not wish to use the automatic switch off, please select “disable”.

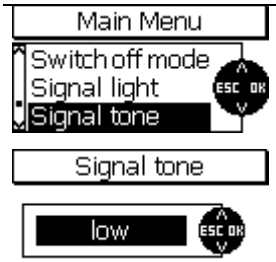


9.9 Signal light



The gauge features a signal light (above the MENU key) to indicate whether a reading is within tolerance (green light) or beyond tolerance (red light). The duration of light signal can be adjusted to “short on”, “off” or “long on”.

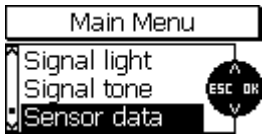
9.10 Signal tone



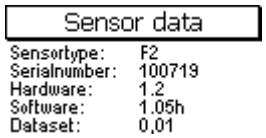
The signal tone is to confirm acquisition of readings and to confirm key action.

Select “Signal tone” from main menu and press OK to confirm. Use arrow up/down keys to set to “low”, “off”, “loud” or “medium

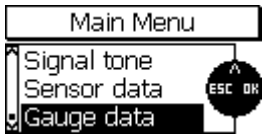
9.11 Sensor data



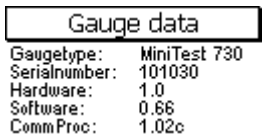
Select “Sensor data” from main menu and press OK to view the sensor specifications. These data should be made available for any service requests.



9.12 Gauge data



Select “Gauge data” from main menu and press OK to view the gauge specifications. These data should be made available for any service requests.



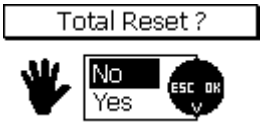
10. Additional Functions

10.1 Initializing

This function can be called at the first setting into operation or later at any time.
The gauge is switched off. Press ON/OFF button together with ESC key. Then release ON/OFF button first.

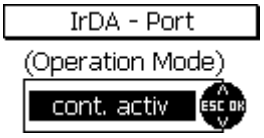
An initializing sequence will be called consisting of 4 steps;

1. Language
”English” will appear, regardless of the language that has been set previously.
Use arrow up/down keys to select the requested language.
Press OK to confirm or press ESC to abort and go back to the previous setting.



2. Total Reset
The next step will be “Total Reset”. A total reset restores the factory settings. If you do not wish to restore the factory settings, use arrow up/down keys to select “No”. Press OK to confirm. Press ESC to abort action.

Attention !!
If you select “Yes“, all data will be irrevocably deleted. All settings (except the language setting) will be reset to factory setting.
All batches including readings, statistics and calibration values will be deleted.

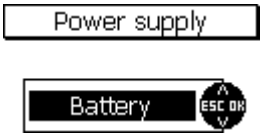


3. IrDA – Port
Setting options are “continuously active“ or “automatic“.
If you select “cont. active” a permanent IrDA connection will be established from the MiniTest gauge to a PC or printer in reach. The PC in range will identify an active wireless connection and the status

line showing „MiniTest 7 within range“. If further IR devices are within the range of the PC, the message “Several computers/devices within range” will appear. The “cont. active” setting is recommended if you wish to access your MiniTest data via a PC programme.

The “automatic“ option will establish a temporary IrDA connection once a printing process has been started on the gauge. As soon as printing is completed, the IrDA connection will be disconnected. The “automatic” option is less power consuming.

Use arrow up/down keys to set to the requested option. Press OK to confirm.

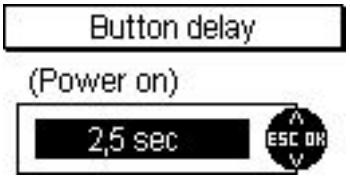


4. Power supply

Setting options: “Battery“ or “Accumulator”.

The battery indicator „▭“ works according to the type of power source you are using and is related to its nominal voltage. It is important to adjust the correct power source. Use arrow up/down keys to make your selection and press OK to confirm. If you set to the wrong power source, the battery indicator and the automatic low voltage switch-off will not work properly.

5. Button delay



The key reaction delay can be adjusted to the following options: ”OFF“, “1.0 sec“, “1.5 sec“, “2.0 sec“, “2.5 sec“, “3.0 sec“, “3.5 sec“, “4.0 sec“, “4.5 sec“, “5.0 sec“.

To prevent the gauge from unintentional switch ON or OFF, you can adjust the ON/OFF button to the above key reaction delay times. If, for instance, you have adjusted a delay time of “2,5 sec”, the ON/OFF button must be pressed for 2.5 seconds to switch the gauge ON or OFF. Use arrow up/down keys to adjust the requested delay time. Press OK to confirm. Please note that the ON/FF key will respond with the set delay accordingly.

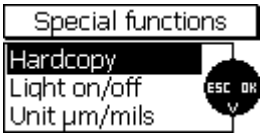
10.2 Special functions

The gauge is switched ON. Press ON/OFF button for more than one second, the “Special functions” menu will appear. You can call this menu at any time. The special functions menu offers you quick access to the following items:

- Hardcopy: for print-out of screenshots or transfer to a PC
- Light on/off: to toggle between enable/disable display backlight
- Units µm/mils: to toggle between µm and mils

The quick toggle function to switch between the measuring units is recommended for countries that are using both measuring units. If you change the measuring unit, the values will be refreshed accordingly.
Once you have activated the special functions menu, use arrow up/down keys to make your selection. Press OK to confirm or press ESC to abort and to return to the previous display.

Quick reference of Special functions:

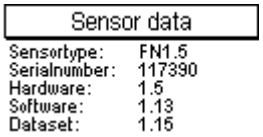


Hardcopy:	print-out of screenshots on the MiniPrint data printer or transfer to a PC
Light on/off:	toggle between enable/disable display backlight
Units µm/mils	toggle between metric system (µm/mm) and imperial system (mils/inch)

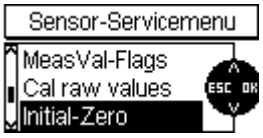
10.3 Readjusting the factory zero-point

With any calibration method including a zero reference point, a so-called correction for geometry is carried out when taking the zero reference point. The geometry correction determines the surface curvature of the sample by identifying its deviation from curvature at the zero-point of reference standard and a correction of the complete sensor characteristics is carried out accordingly. That's why in most cases, a zero-point calibration will prove to be sufficient. For using this correction method, it is required that the gauge is set to the factory pre-settings and no deviations can be observed and when taking zero-point measurements on the test sheets supplied with the gauge. When taking readings on the test sheets, zero should be shown as precisely as possible. This is usually the case.

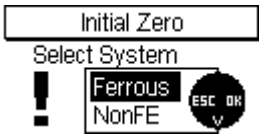
If deviations from zero-point are higher than specified on the respective sensor data sheet (i.e. higher than the fixed proportion of specified tolerance, i. e. 1.5µm with the FN5 sensor), it is recommended to readjust the factory set zero-point.



Readjustment is made in the sensor service menu. This is available in English only and can be accessed via the sensor data menu. Select view sensor data and press the following keys subsequently: arrow up and menu key. Press OK to confirm.

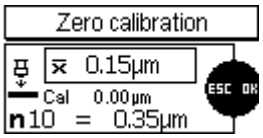


Select "Initial-Zero" form the sensor service menu.



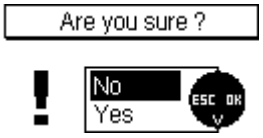
If a dual sensor is connected, i.e. the FN 1.5/0.7, a menu to select the measuring principle will appear.

Choose the measuring principle (for ferrous or non-ferrous) for which you would like to take the zero measurement.



The readjustment must be carried out very carefully. Please use a blank and smooth substrate. Remove any residues of grease or oil, metal cuttings or other if necessary from the substrate or sensor pole. Any foreign matter will distort calibration. Please refer also to section 6.1 for general remarks on calibration.

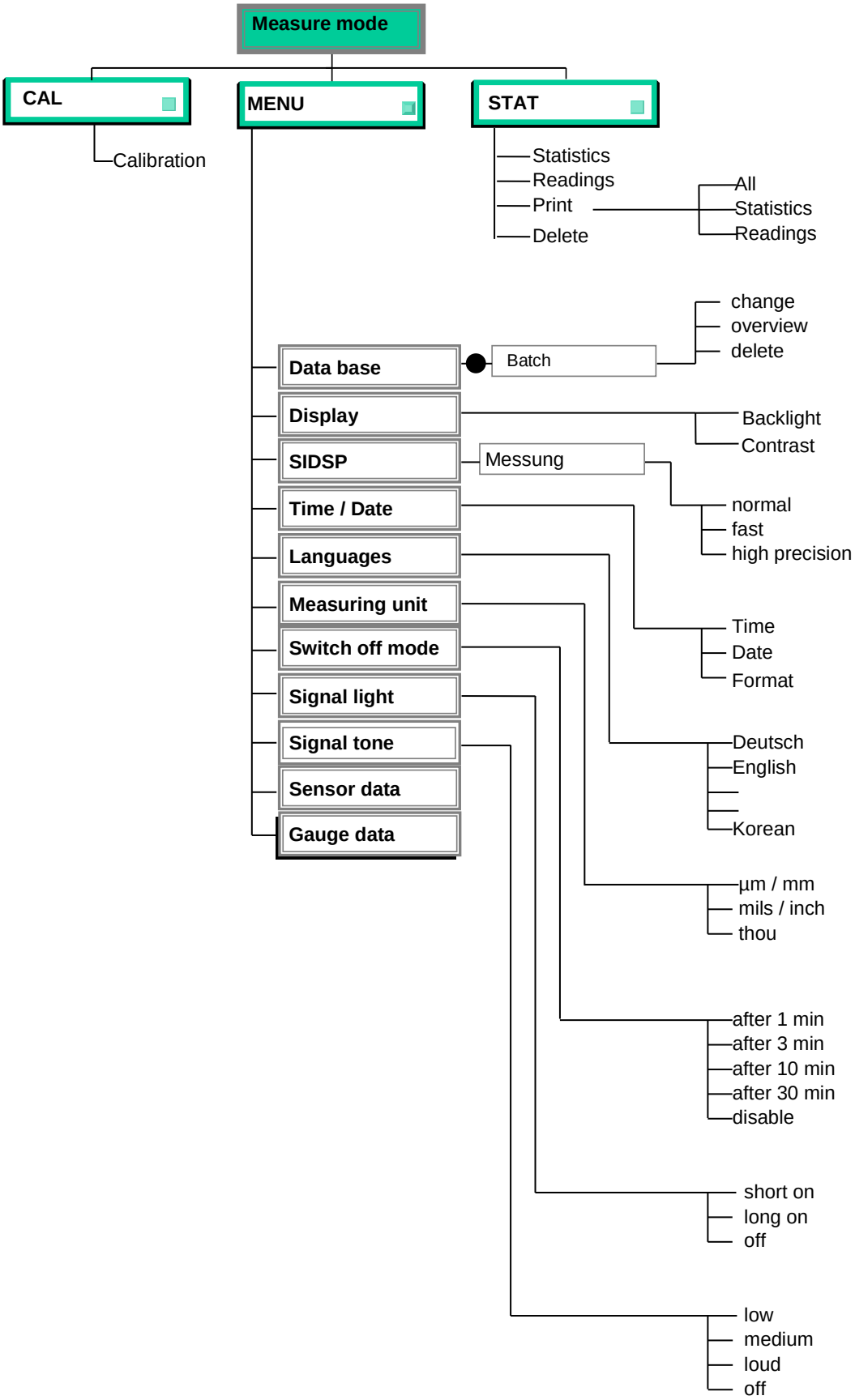
Carry out calibration according to 6.2.2.1. After pressing OK, a security prompt appears to ask you whether to replace the factory pre-settings by you current zero-point readjustment.



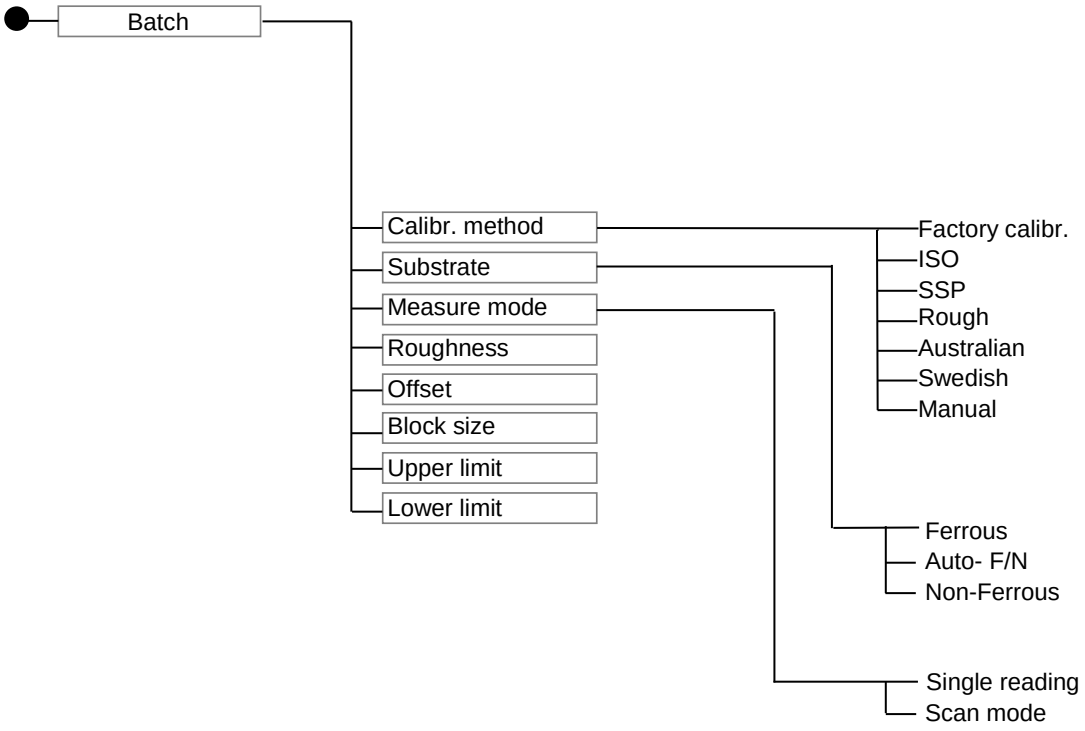
Press OK to replace it or ESC to abort. If you abort, the factory pre-setting remains valid.

11. Quick reference

11.1 Synopsis



11.2 How to create a Batch



12. Care and Maintenance

12. 1 Care

Use a soft damp cloth with water or a mild detergent to clean the gauge and accessories.

Caution:
Do not use solvents because they might damage the plastic parts. Do not use metal brushes or other tools for cleaning the sensor tip.

12.1.1 Using NiMH rechargeable batteries

To achieve optimal service life of the NiMH rechargeable batteries, please respect the following instructions.

- Before the first use, the NiMH rechargeable batteries should be discharged and recharged in three subsequent cycles in order to ensure their maximum capacity. This procedure is also recommended to restore the full capacity of used rechargeable batteries.

- If the MiniTest will not be used a longer period of time, remove the NiMH batteries before storing the gauge. Please note that even if the gauge is switched off, a faint current will flow which as a consequence will lead to deep discharge after some time. Deep discharge might destroy batteries and must be prevented in any case.

- For extended storage periods (more than six months) NiMH rechargeable batteries must be kept in charged state. In addition, it is recommended to reload at least once a year. Recommended battery storage temperature: form +10 ºC to +30 ºC at a relative air humidity of 50%.

- Try to save battery life e. g. by operating the MiniTest in auto switch-off mode, instead of continuous service. This is to avoid current consumption if the gauge is idle for a while.

12.2 Maintenance

Generally, no maintenance work is required for MiniTest 700 series.

Please note: Repairs may only be carried out by authorized ElektroPhysik staff.

13. Technical Data

13.1 Gauge specifications

Model / Characteristics	MiniTest 720	MiniTest 730	MiniTest 740
Sensor type	built-in, fixed sensor	external, fixed sensor	convertible from built-in to external sensor
Batch memories	10	10	100
Number of storable readings	10,000	10,000	100,000
Measuring principle	magnetic induction, eddy currents		
Statistics	Number of readings, minimum, maximum, average, standard deviation, coefficient of variation, block statistics (norm-conforming / freely configurable		
Calibration methods	works calibration, zero-, 2-point and 3-point calibration		
Calibration methods conforming to	“ISO” - ISO 19840:2004(E), “SSPC” - SSPC-PA2(May 1, 2004), “Swedisch” - SS 184160 (1992-03-11), “Australian” - AS 3894.3-2002		
Display	128 x 64 Dots graphics display, backlit		
Signal transducer	Magnetic Transducer , adjustable from high (approx. 70dB) to OFF		
Measuring units	µm, mm, cm; mils, inch, thou		
User selectable tolerance limits with monitoring option	Audible and visual alarm to monitor deviations from tolerance limits		
Offset function	adds or subtracts a constant value to / from the reading		
Languages	German, English, Korean, etc (25 languages max.)		
Data port	IrDA 1.0 (Infrared)		
Power supply	2 x AA mignon cells		
Battery life	approx. 30.000 measurements (with display backlight switched off)		
Date / Time	Current time; date and time of creation / last modification of a batch. If a printer or a PC is connected, the date and time of print-out and date of last modification of a batch will be included.		

Measuring speed in scan mode	20 readings per second		
Measuring speed in single readings mode	70 readings max per minute in “fast“ measuring mode		
Protection type of housing	IP 40		
Norms and standards	DIN EN ISO 1461, 2064, 2178, 2360, 2808, 3882, 19840 ASTM B244, B499, D7091, E376 AS 3894.3, SS 1841 60, SSPC-PA 2		
Dimension of gauge	157 x 75,5 x 49 mm		
Weight	approx. 175 g	approx. 210 g	approx. 175 g with built-in sensor/ approx. 230 g with external sensor
Dimensions pouch	200 x 100 x 80 mm		
Operating temperature, gauge	-10° ... +60°C		
Storing temperature, gauge	-20° ... +70°C		
Operating temperature, sensor	-10° ... +60°C		
Storing temperature, sensor	-20° ... +70°C		

13.2 Sensor specifications

Sensor type / Characteristics	F 1.5*[1], N 0.7, FN 1.5*[1]		F 2	F5, N 2.5, FN5		F15
	F	N	F	F	N	F
Measuring range	0..1,5 mm	0..0,7 mm	0..2 mm	0..5 mm	0..2,5 mm	0..15mm
Field of application	Especially designed for measurements on small objects and of thin coatings, recommended for use with measuring stand.		Especially designed for measure-ment of coatings applied on rough surfaces	Suitable for standard-type applications		Suitable for measurement of thick coatings.
Measuring principle	magnetic induction	eddy currents	magnetic induction	magnetic induction	eddy currents	eddy currents
Signal processing	sensor integrated digital 32-bit signal processing (SIDSP®)					
Accuracy: Factory calibration Zero calibration Multi-point calibration	 ± (1µm + 3% of reading) *[4] ± (1µm +1,5%of reading) ± (1µm + 0,75% of reading)*[3]		 ± (1,5 µm + 3% of reading) *[4] ± (1,5 µm + 1,5% of reading) ± (1,5 µm + 0,75 % of reading) *[3]			 ± (5 µm + 3 % of reading)*[4] ± (5 µm + 1,5 % of reading) ± (5 µm + 0,75 % of reading)*[3]
Repeatability (standard deviation)*[7]	± (0,5 µm + 0,5% of reading)		± (0,8 µm + 0,5 % of reading)			±(2,5µm + 0,5 % of reading)
Low range resolution	0,05 µm		0,1 µm			1,0 µm
Smallest curvature radius convex*[2]	1,0 mm		1,5 mm			5 mm
Smallest curvature radius concave (external sensor without prism)*[2]*[5]	7,5 mm		10 mm			25 mm
Smallest curvature radius concave (built-in sensor)*[2]	30 mm		30 mm			30 mm

Min. measuring area *5 *6	∅ 5mm		∅ 10 mm			∅ 25 mm
Min. substrate thickness*2	0,3 mm	40 µm	0,5 mm	0,5 mm	40 µm	1 mm
Measuring speed in scan mode	20 readings / second					
Measuring speed in single readings mode	70 readings max per minute in “fast“ measuring mode					
Dimensions and weight of external sensor	∅ 15 x 76,5 mm / 65g		∅ 15 x 76,5mm / 65g			∅ 23 x 76,5mm / 70g

*1 not suitable for rough surfaces

*2 with zero point and multi-point calibration

*3 if calibration is made close to the thickness to be expected and related to ElektroPhysik precision standards

*4 if the measuring objects has the same material, shape and roughness as the reference zero plate supplied with the gauge.

*5 using the precision measuring stand

*6 with multi-point calibration

*7 according to DIN 55350, part 13

13.3 Delivery schedule

13.3.1 MiniTest 720 with built-in SIDSP® sensor

Description		Article #
MiniTest 720 with SIDSP® sensor for non-magnetic coatings applied on ferrous substrates and steel, also on steel alloys and hardened steel (magnetic induction principle)	F1.5	
	F2	
	F5	
	F15	
MiniTest 720 with SIDSP® sensor for all electrically insulating coatings applied non non-ferrous metals and on austenitic steel (eddy currents principle)	N0.7	
	N2.5	
MiniTest 720 with SIDSP®sensor, works according to the magnetic induction and on the eddy currents principle	FN1.5	
	FN5	
Each model comes with: - padded soft pouch with shoulder strap and belt clip - 1 and/or 2 reference zero plate(s) - 2 precision standards - operating manual on CD-Rom with German, English, French and Spanish instructions - hand strip - 2 x AA Mignon batteries		

13.3.2 MiniTest 730 with external SIDSP®sensor

Description		**Article #**
MiniTest 730 with SIDSP® sensor for non-magnetic coatings applied on ferrous substrates and steel, also on steel alloys and hardened steel (magnetic induction principle)	F1.5	
	F2	
	F5	
	F15	
MiniTest 730 with SIDSP® sensor for all electrically insulating coatings applied non non-ferrous metals and on austenitic steel (eddy currents principle)	N0.7	
	N2.5	
MiniTest 730 with SIDSP®sensor, works according to the magnetic induction and on the eddy currents principle	FN1.5	
	FN5	
Each model comes with: - padded soft pouch with shoulder strap and belt clip - 1 and/or 2 reference zero plate(s) - 2 precision standards - operating manual on CD-Rom with German, English, French and Spanish instructions - hand strip - 2 x AA Mignon batteries		

13.3.3 MiniTest 740 with convertible SIDSP® sensor

Description	**Article #**
MiniTest 740, Basic unit **without** sensor	
comes with: - padded soft pouch with shoulder strap and belt clip - adapter cable for external SIDSP® sensor - operating manual on CD-Rom with German, English, French and Spanish instructions - hand strip - 2 x AA Mignon batteries	

13.3.4 Convertible SIDSP®sensors for MiniTest 740

Description		**Article #**
SIDSP® sensor for non-magnetic coatings applied on ferrous substrates and steel, also on steel alloys and hardened steel (magnetic induction principle)	F1.5	
	F2	
	F5	
	F15	
SIDSP® sensor for all electrically insulating coatings applied non non-ferrous metals and on austenitic steel (eddy currents principle)	N0.7	
	N2.5	
SIDSP® sensor works according to the magnetic induction and on the eddy currents principle	FN1.5	
	FN5	
Each sensor comes with : - 2 measuring prisms for built-in and external sensor connection (except F15 sensor) - 1 and/or 2 reference zero plate(s) - 2 precision standards		

13.4 Accessories

Description	Article #
MiniPrint 7000 data printer incl. charger unit	70-171-0001
Thermo paper roll 58 x ∅31mm for MiniPrint 7000	06-007-0007
Quick charger for NiMH rechargeable batteries	02-070-0001
NiMH rechargeable battery, Mignon AA HR6 1,2V (2 pcs required)	02-064-0001
Mignon cells AA LR6 1,5V (2 pcs required)	02-064-0008
Rubber protection case with neck strip	82-010-0065
Precision stand (only for MiniTest 730 and/or 740, for measuring range up to 5mm)	
IR / USB adapter unit for wireless data transfer	85-139-0014
Precision standards (please ask for special list)	
MSoft 7000 basic data transfer software (German, English, French)	80-901-1600
MSoft 7000 pro Software data managing software (German, English, French)	80-901-xxxx
Manufacturer's Test Certificate according to (DIN 55350 M) for coating thickness gauges of the MiniTest 700 series	82-170-0001
Manufacturer's Test Certificate according to (DIN 55350 M) for precision standards	

14. Annexe

14.1 Error messages and remedy

Error message	Cause of the problem	Remedy
„Please check clock settings !!!“	The gauge has been cut from power supply for more than one minute. (If the gauge has been supplied without batteries or after battery change)	Check clock settings. If necessary reset clock (see section 9.5)
„Battery almost empty“	Low battery. Though you can continue for some time, batteries should be replaced.	Replace batteries or reload rechargeable batteries. Used batteries should not be disposed of with the domestic refuse. Please dispose of used batteries in accordance with the statutory regulations.
„Low battery! “	This message briefly appears before batteries are completely discharged. The gauge switches off. Batteries must be replaced / recharged before you can continue to use the gauge.	Replace batteries or reload rechargeable batteries. Used batteries should not be disposed of with the domestic refuse. Please dispose of used batteries in accordance with the statutory regulations

Error message	Cause of the problem	Remedy
Backlight failure ! Replace battery !	The display cannot be backlit due to low voltage. You can continue to use the gauge without backlight for some time. Fresh batteries should be made available.	Replace batteries or reload rechargeable batteries. Used batteries should not be disposed of with the domestic refuse. Please dispose of used batteries in accordance with the statutory regulations
Please hold sensor into the air to obtain infinite value !	At switch, sensor was hold too close to metal part.	Make sure to keep a safety distance from metal parts at switch on. The sensor should be kept in a distance from metal parts of at least 5 times the measuring range. The gauge switches automatically to measuring mode.
Refresh infinite value!	Make sure to refresh the infinite value from time to time. This is vital to obtain the measuring accuracy a specified.	Remove sensor from measuring object and wait for the message to disappear. During measurement, you can refresh the infinite value by pressing ESC. However, this is only be recommended in exceptional cases because measuring accuracy will be affected by this procedure.

Error message	Cause of the problem	Remedy
MiniTest 740 only: Sens./batch incomp. Delete readings? No Yes	The sensor data stored in the currently active batch do not match the data of sensor you are currently using.	If you wish to continue to use the current batch, the readings must be deleted. If you wish to keep readings stored, select "NO" for "Delete readings?"
Sensor not matching batch !	The sensor data stored in the currently active batch do not match the data of sensor you are currently using.	Chose another batch or create a new one (MiniTest 740 only).
MiniTest 740 only: Recalibration required !	The currently active batch has stored readings taken by a sensor of the same type but which is not identical with the one currently connected.	Please carry out calibration in the current batch.
Invalid calibration. Recalibrate?	This message appears after a batch has been created and if a predefined calibration method (ISO, SSPC, Rough, Australian or Swedish) has been selected.	Please recalibrate.
Memory full !	The maximum number of storable readings has been exceeded.	Please delete readings or batches from the data base you don't need any more.

Error message	Cause of the problem	Remedy
Check sensor connection !	Gauge sensor interrupt during operation. Possible causes: The external sensor has been disconnected during operation. or The internal sensor has been disconnected during operation through - loose sensor connection - defective cable - defective sensor	Please for check reason of error. If the sensor seems to be defective, please exchange by another one or contact the ElektroPhysik after-sales service.
No sensor found !!!	After switch-on, the gauge cannot establish a connection to the sensor. Possible causes: - no sensor connected - loose sensor connection - defective cable - defective sensor	Please check for reason of error. When using MiniTest 740: Please try to use the senor in the internal mode. If it works in this mode, the sensor cable is the cause of error. Please replace sensor cable. If a defective sensor is the cause of error, please replace by new one or contact ElektroPhysik after sales service.

Error message	Cause of the problem	Remedy
No printer or PC found !	IR connection failure between gauge and printer or PC.	Switch on printer and/or check the port setting of your PC. Make sure to position the IR devices correctly and restart data transfer.
Data transfer error !	IR connection failure during data transfer procedure.	Make sure to position the IR devices correctly and restart data transfer.
Unsuitable substrate (eg. magnetic) Unsuitable substrate (e.g. ferritic) Substrate/coating combination not suitable!	The calibration you have made is not suitable for the shape or substrate of measuring sample. The first two messages occur in the Auto-FN mode, the other one in the F or N mode.	Please carry out calibration on an object which in shape and substrate material is similar to the later object to be measured.
„Sensor-Problem ! Bitte wenden Sie sich an den Service.“ Sensor failure ! Please contact after-sales service.		Please contact after-sales service.

The following errors may be remedied by a Total Reset (Please refer to section 10.1 on how to perform a total reset):

- no response to key action
- reading acquisition failure
- illogical readings

If you are not able to switch the gauge off via the ON/OFF button, please remove and reinsert batteries.

14.2 Statistical Terms

The statistical evaluation will help you to assess the quality of your product.

Average (Mean) $\bar{x}$

The sum of single readings divided by the total number of readings.

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

Variance

The variance of a list is the square of the standard deviation of the list, that is, the average of the squares of the deviations of the numbers in the list from their mean divided by the (number of readings minus 1).

$$\text{var} = \frac{\sum (x - \bar{x})^2}{n - 1}$$

Standard Deviation (STD. DEV.) s (s = σ = sigma)

The sample standard deviation is a statistic that measures how “dispersed“ the sample is around the sample mean. The sample standard deviation increases with increasing spread out. The standard deviation of a set of numbers is the root mean square of the variance **s².**

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

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

Variation coefficient (Var.-coeff.)

The variation coefficient is the standard deviation divided by the arithmetic mean. The variation coefficient is indicated in percent.

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

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14.3 Safety Notes

Safe operation will be ensured as far as the instructions and notes in this manual and on the gauge display will be observed.

For installation work, please cut power supply. Use only original spare parts and/or accessories!

	**Rechargeable batteries and accessories** Make sure to use only original accessories and batteries supplied/recommended by the manufacturer of gauge. Connect only to compatible peripheral devices.
	**Connecting other devices** If you connect the gauge to another device, please refer to the corresponding instructions manual for detailed information on safety issues. Do only connect original accessories recommended by the manufacturer of the MiniTest 700 series.
	**Keep away from water** The measuring unit is not waterproof. Keep in a dry place.
	**Keep away from explosion-hazardous area!**
	**Approved after-sales service** The gauge may only be repaired by approved and qualified after-sales service personnel.
	**Medical facilities** Please ask for permission before using the gauge in medical facilities.

14.4 Declaration of Conformity

We, ElektroPhysik, Pasteurstr. 15, D-50735 Cologne, Germany, declare in sole responsibility that the products MiniTest 720, MiniTest 730 and MiniTest 740 to which this declaration relates is in conformity with the provisions of directive 89 / 336 / EEC (Electromagnetic compatibility), in Germany: EMVG (Gesetz über die elektromagnetische Verträglichkeit) of November, 9th, 1992.

14.5 After Sales Service

All models of the MiniTest 700 series are manufactured according to state-of-the-art production methods using high-class components. Careful production controls along with a Certified Quality Management according to DIN EN ISO 9001 ensure optimum product quality.

In case of errors please contact ElektroPhysik or your local dealer. If repairs should become necessary, please send the gauge to ElektroPhysik or contact your local ElektroPhysik representative for return and repair instructions.

Please note that the gauge should only be repaired by authorized, skilled and trained personnel. Service attempts by untrained personnel could cause extensive damage to the gauge and possibly void any and all warranties.

Please retain original packing for returning the gauge in case of repair.

For more detailed information on the use, applications, service or technical data, please contact ElektroPhysik or your local ElektroPhysik representative.

ElektroPhysik Dr. Steingroever GmbH & Co. KG
Pasteurstr. 15

D-50735 Köln

Phone: +49 (0)221 75204-0
Fax: +49 (0)221 75204-67
E-Mail: info@elektrophysik.com

For company details of ElektroPhysik representative in your country please click on

http://www.elektrophysik.com/company/agents/index.html

15. Change history

This section includes changes (if any).

16. Index