

## Technical Manual / Operating Instructions

### MiniTest 7400

Coating Thickness Gauge



© ElektroPhysik  
Version 1.0 08.11.2011  
Subject to change without notice

ElektroPhysik  
Dr. Steingroever GmbH & Co. KG  
Pasteurstr. 15  
50735 Cologne, Germany

---

Table of contents

<b>1. Introduction</b> .....	<b>7</b>
<b>2. First Steps</b> .....	<b>9</b>
<b>2.1 Insert batteries and connect sensor</b> .....	<b>9</b>
<b>2.2 Switch ON and take readings</b> .....	<b>10</b>
2.2.1 Setting language.....	10
<b>3. Description of the Measuring System</b> .....	<b>12</b>
<b>3.1 Display unit</b> .....	<b>12</b>
3.1.1 General properties.....	12
3.1.2 Operating keys .....	12
3.1.3 Sockets and interfaces .....	13
3.1.4 Power supply .....	14
3.1.4.1 Batteries and storage batteries .....	14
3.1.4.2 Plug-in mains unit .....	15
<b>3.2 Sensor</b> .....	<b>16</b>
3.2.1 SIDSP <sup>®</sup> technology.....	16
3.2.2 Further sensor properties .....	17
<b>4. User Interface</b> .....	<b>18</b>
<b>4.1 Switch-ON and START screen</b> .....	<b>18</b>
<b>4.2 Screens</b> .....	<b>19</b>
4.2.1 Measure Mode Screen / Numerical Display .....	19
4.2.2 Online statistics .....	19
4.2.3 Statistics screen .....	20
<b>4.3 User Menu</b> .....	<b>21</b>
4.3.1 User Preferences .....	21
4.3.2 Numerical Entries .....	22
4.3.3 Alphanumerical Entries (on MiniTest 7400).....	22
<b>5. Measure Mode</b> .....	<b>23</b>
<b>5.1 Important Notes on Thickness Measurement</b> .....	<b>23</b>
5.1.1 How to interpret readings .....	23
<b>5.2 Settings to make before measurement</b> .....	<b>23</b>
5.2.1 Batch.....	23
5.2.2 Calibration .....	24
<b>5.3 Taking readings</b> .....	<b>25</b>
5.3.1 Taking readings without using the sensor stand .....	25

5.3.2 High-precision measuring stand .....	26
5.3.3 Measurement of double-layer coatings.....	26
5.3.4 Grouping readings into blocks.....	28
<b>5.4 Error sources.....</b>	<b>28</b>
<b>6. Calibration .....</b>	<b>29</b>
<b>6.1 General remarks.....</b>	<b>29</b>
<b>6.2 Calibration methods .....</b>	<b>31</b>
6.2.1 Factory calibration .....	31
6.2.2 Manual calibration method .....	31
6.2.2.1 Zero calibration .....	31
6.2.2.2 Two-point calibration.....	32
6.2.2.3 Multi-point calibration .....	32
6.2.2.4 Two-point calibration without zero point.....	32
6.2.3 Pre-defined and menu-guided calibration methods.....	33
6.2.3.1 General remarks .....	33
6.2.3.2 Calibration according to ISO (EN ISO 19840) .....	33
6.2.3.3 Calibration method „rough“ .....	34
6.2.3.4 Calibration method “Swedish” (SS 18 41 60).....	34
6.2.3.5 Calibration method “Australian” .....	35
6.2.3.6 Calibration according to SSPC-PA2.....	36
6.2.3.7 Calibration according to PSPC .....	36
<b>6.3 Shot-blasted and rough surfaces .....</b>	<b>37</b>
6.3.1 General remarks.....	37
6.3.2 Method A (Roughness Rz > 20µm) .....	37
6.3.3 Method B (Roughness Rz < 20µm) .....	38
6.3.4 Method C .....	38
<b>6.4 How to calibrate .....</b>	<b>39</b>
6.4.1 General remarks.....	39
6.4.2 Factory Setting .....	39
6.4.3 Manual calibration .....	40
6.4.3.1 Calibrating FN sensors .....	40
6.4.3.2 Zero Point calibration .....	40
6.4.3.3 Two-point calibration.....	41
6.4.3.4 Multi-point calibration .....	43
6.4.3.5 Two-point calibration without zero.....	46
<b>6.5 How to recalibrate.....</b>	<b>48</b>
<b>6.6 Interrupt or abort a calibration procedure .....</b>	<b>48</b>

6.7	<b>Delete a calibration point</b> .....	49
<b>7.</b>	<b>Data management</b> .....	<b>50</b>
7.1	<b>Batches</b> .....	50
7.1.1	General remarks .....	50
7.1.2	Memory capacity and structure .....	50
7.1.3	Setting parameters .....	50
7.2	<b>Database</b> .....	52
7.2.1	General remarks .....	52
7.2.2	Create a directory .....	52
7.2.3	Create a batch .....	53
7.2.4	Select a measuring series .....	54
7.2.5	Delete a batch or directory .....	55
7.2.6	Rename a batch or a directory .....	56
<b>8.</b>	<b>Statistics / Statistical Evaluation</b> .....	<b>57</b>
8.1	<b>General remarks</b> .....	57
8.2	<b>Parameters for statistics calculation</b> .....	57
8.2.1	Upper and lower specification limits .....	57
8.3	<b>View statistics</b> .....	58
8.3.1	View statistics if grouping into measuring blocks is disabled .....	58
8.3.2	View single readings .....	58
8.3.3	Histogram with MiniTest 7400 .....	59
8.3.4	Trend diagram with MiniTest 7400 .....	59
8.3.5	View statistics if grouping into measuring blocks is enabled .....	60
8.3.6	View single readings and single block statistic .....	61
8.4	<b>Delete readings of a batch</b> .....	63
8.4.1	Delete single readings .....	63
8.4.2	Delete all readings .....	63
8.4.3	Delete a current reading .....	63
<b>9.</b>	<b>Data output / Data transfer</b> .....	<b>64</b>
9.1	<b>Print-out data</b> .....	64
9.2	<b>Transfer data to a PC (terminal program)</b> .....	65
9.3	<b>Transfer of data to a PC (MSoft 7)</b> .....	67
<b>10.</b>	<b>Main menu</b> .....	<b>68</b>
10.1	<b>General remarks</b> .....	68
10.2	<b>Database</b> .....	68
10.3	<b>Statistics</b> .....	68
10.4	<b>Calibration</b> .....	68

<b>10.5 Active Batch</b> .....	<b>69</b>
10.5.1 Batch properties .....	69
10.5.2 Readings .....	69
10.5.3 Configuration .....	70
10.5.4 Calibration .....	73
<b>10.6 Settings</b> .....	<b>74</b>
10.6.1 General remarks.....	74
10.6.2 Display .....	74
10.6.3 Date / Time .....	75
10.6.4 Data output .....	75
10.6.4.1 Data output Infrared (IrDA®) .....	75
10.6.4.2 Data output RS232 Cable.....	76
10.6.4.3 Switch function.....	78
10.6.5 User preferences .....	79
10.6.6 Gauge specifications .....	80
<b>10.7 SIDSP® menu</b> .....	<b>81</b>
<b>11. Special functions</b> .....	<b>82</b>
<b>11.1 Initialization</b> .....	<b>82</b>
<b>11.2 Special functions menu</b> .....	<b>83</b>
<b>11.3 Recalibrate the factory zero point</b> .....	<b>84</b>
<b>12. Synopsis of functions</b> .....	<b>86</b>
<b>12.1 Quick reference</b> .....	<b>86</b>
<b>12.2 How to configure a batch</b> .....	<b>87</b>
<b>13. Care and maintenance</b> .....	<b>88</b>
<b>13.1 Care</b> .....	<b>88</b>
13.1.1 Using NiMH storage batteries .....	88
<b>13.2 Maintenance</b> .....	<b>89</b>
<b>14. Technical data</b> .....	<b>90</b>
<b>14.1 Gauge specifications</b> .....	<b>90</b>
<b>14.2 Sensor specifications</b> .....	<b>91</b>
<b>14.3 Supply schedule</b> .....	<b>93</b>
14.3.1 MiniTest 7400 Coating thickness gauge.....	93
14.3.2 Interchangeable SIDSP® sensors for MiniTest 7400.....	93
14.3.3 Accessories for SIDSP® sensors .....	95
<b>14.4 Accessories</b> .....	<b>96</b>
<b>15. Annexe</b> .....	<b>97</b>

---

<b>15.1 Error messages and troubleshooting .....</b>	<b>97</b>
<b>15.2 Statistical Terms .....</b>	<b>100</b>
<b>15.3 Safety notes.....</b>	<b>102</b>
<b>15.4 Declaration of Conformity .....</b>	<b>103</b>
<b>15.5 After Sales Service .....</b>	<b>104</b>
<b>Index .....</b>	<b>105</b>

---

## 1. Introduction

This instruction manual contains all information necessary for the use of the described product MiniTest 7400. Considering the broad range of application was necessary to compile a very detailed and comprehensive instructions manual. We recommend to refer to the table of contents to look up the sections in this manual relevant for your application. For your quick reference, please refer to section 2.2 providing short instructions along with an operating example.

According to the sensor connected, the non-destructive coating thickness gauge MiniTest 7400 uses the magnetic inductions principle or the eddy currents principle and conforms to the following 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	MSC.215(82) -
DIN EN ISO 2808		PSPC
DIN EN ISO 19840		

Due to its robust design, the MiniTest 7400 gauge is suitable for the non-destructive, quick and precise coating thickness measurement in the laboratory as well as on the shop floor or in rough environments. Typical fields of application include the finishing industry, electroplating, paint, chemical, car, aeroplane and chemical industries, general machine and apparatus construction. MiniTest 7400 is the ideal tools for ingoing inspection or quality control for manufacturers, endusers, authorities and experts.

The measuring system comprises a sensor and a display unit MiniTest 7400.

Designed for user-friendly operation, MiniTest 7400 features an intuitive menu control with context-sensitive online help. Large backlit control keys allow extra comfort. Excellent viewing conditions are provided by the large backlit graphics display allowing convenient usage at night and in conditions of poor visibility.

The advanced PC-like data management offers quick creation of folders and easy set-up of customized batches.

Featuring a configuration assistant, the MiniTest 7400 simplifies the calibration and parameter set-up allowing to solve also difficult settings of task in a minimum of time without the need for special skills.

---

In order to meet the requirements of high precision measurement, the MiniTest 7400 sensors can be calibrated at a maximum of 5 points (incl. zero). Predefined calibration methods are available to carry out measurement conforming to the Industrial norms and standards ISO 19840, SSPC, "Swedish", and "Australian". In addition, a special calibration method is available for measurements on rough surfaces as well as the 90/10 function according to IMO Performance Standard for Protective Coatings (PSPC).

The delivery schedule includes the PC software package "MSoft 7 Professional" for convenient set up and evaluation of measuring groups and export in various data formats. The software exports data as text documents, Excel® spread sheets or in the PDF file format and allows entries of notes and annotations. Special features: also pictures of your measuring samples may be added to the data reports.

MiniTest 7400 connects to all SIDSP®- sensors of the MiniTest 7 series. SIDSP® stands for Sensor-Integrated Digital Signal Processing High accuracy, unmatched reproducibility and high temperature stability, these are the main characteristics of SIDSP®. sensors.

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, copper, 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, copper, 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 non-ferrous metal substrates.

Featuring numerous interfaces, MiniTest 7400 connect to peripheral devices such as the portable printer MiniPrint 7000 (available as an option). All models of the MiniTest 7400 series are equipped with an IrDA port (IrDA® 1.0) (infrared). As an option, a multi-purpose adapter unit can be supplied to provide an extra USB interface for connecting a mains unit, headphones, a footswitch and or an alarm device. If only single functions are requested, you can connect an RS232 adapter cable, a USB adapter cable or an IR/USB converter unit.



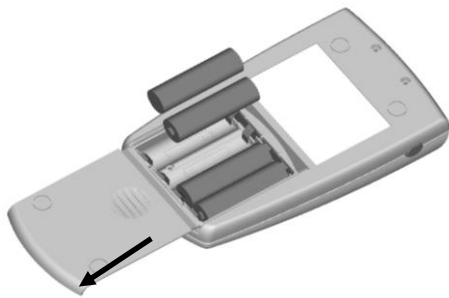
## 2. First Steps

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.

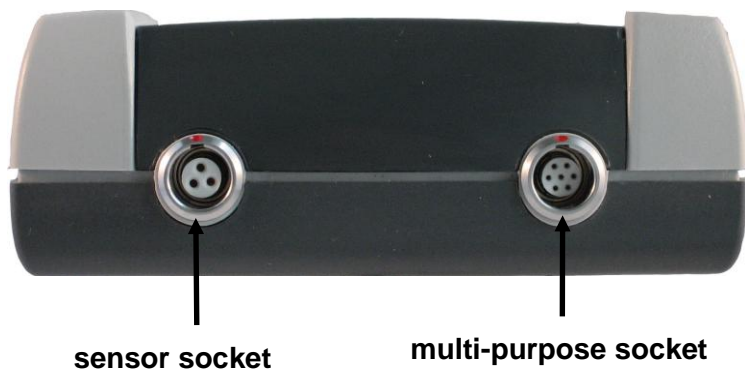
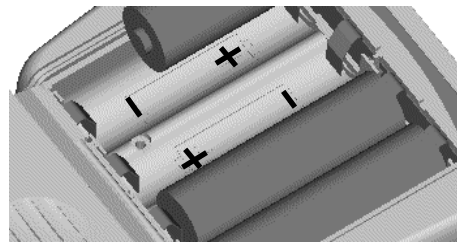
### 2.1 Insert batteries and connect sensor

- a) Take gauge and batteries from the case.
- b) Push the battery compartment lid in direction of the arrow (as shown below).
- c) Insert the batteries supplied with the gauge into the battery compartment. Respect polarities (as shown below).
- d) Push the battery lid over the housing and close housing.
- e) Take the sensor to be connected from the carrying case. Plug sensor into the socket on top of the base unit (see fig). Make sure the nib of plug is correctly inserted into the guide way of socket. The red marking at the probe plug must be positioned correctly to the red marking at the sensor plug.
- f) Fully engage the sensor plug into the sensor socket all the way to the stop.

b)



c)



## 2.2 Switch ON and take readings

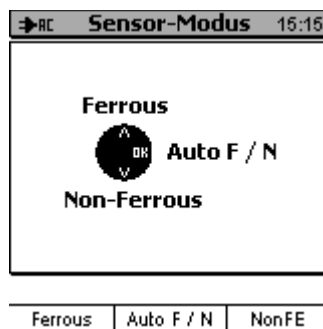
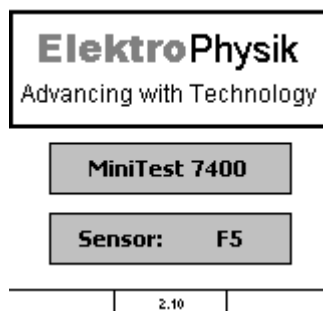
### 2.2.1 Setting language

This setting can be made at initial use or as requested at any time (see section 11.1). If you do not wish to make any language settings, please proceed to section 2.2.2. b).

Press the red ON/OFF button on the left side of gauge and ESC simultaneously. First release ON/OFF key. The initialisation menu will appear.

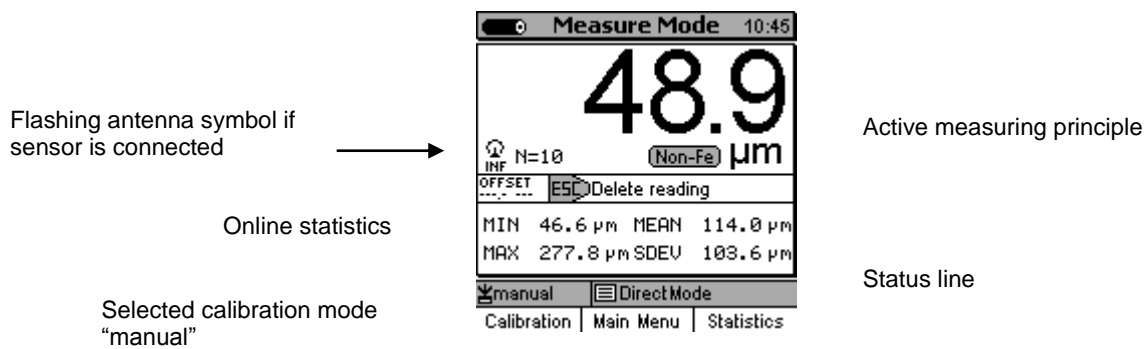
- A banner appears with a language option.  
Use arrow keys  $\uparrow\downarrow$  to go to your requested language option.  
Press OK to confirm or ESC to abort.
- On display appears "Total Reset". A Total Reset restores the factory settings. To abort Total Reset, press Function key "No" (section 11.1)

### 2.2.2 Take readings



- Press ON/OFF key
- The start screen appears with company logo, gauge version the type of sensor connected .
- If you have connected an FN sensor, you can choose the measuring system (as long as you have not taken any readings so far). Use the command and navigation block and press the following keys:
  - Arrow up „ $\uparrow$ “: for „Ferro“ (F = magnetic induction principle)
  - Arrow down „ $\downarrow$ “ for „Non-Ferro“ (N = eddy currents principle)
  - „Ok“ key for „Auto F/N“. If you make no selection, the Auto F/N mode will be activated automatically after 5 seconds.
  - As an alternative you can also use the function keys „Ferro“, „Auto F/N“ „Non-Ferro“ (s. fig. on the left).

- The gauge switches to the measuring mode and is ready for measurement. The measuring screen appear. No reading is shown.
- In the factory setting, the “Direct mode” (see section 7.1.1) is activated. Factory calibration is preset (please refer to section 6 for further information on the calibration modes). The status line indicates the calibration mode along with the “active measuring series”.

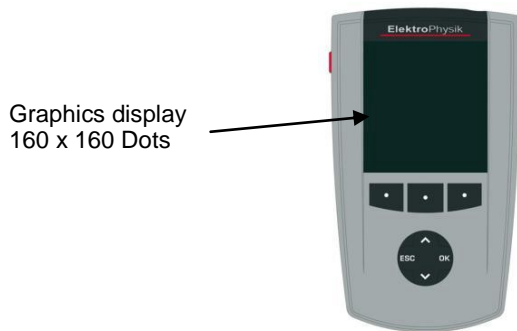


- The calibration mode “factory is for quick and easy measurement if larger measuring errors are acceptable. For other calibration methods please refer to section 6.2.
- For measurement, place the sensor in vertical position on the object to be measured. The thickness is immediately shown on the screen. Remove sensor. Now you can take the next reading.

### 3. Description of the Measuring System

#### 3.1 Display unit

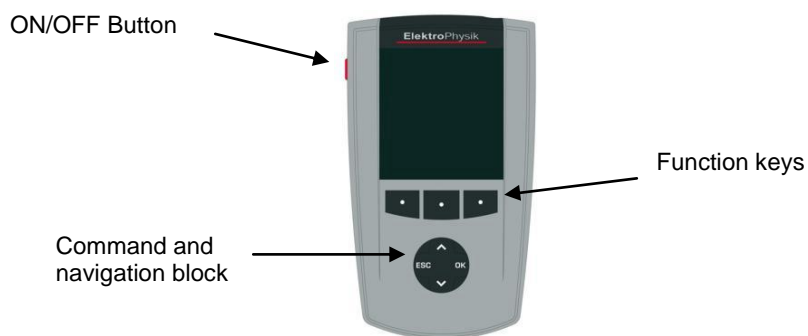
##### 3.1.1 General properties



Large backlit display for easy reading of measuring values, statistical data, histogram and trend diagram.

Robust scratch resistant plastics housing.

##### 3.1.2 Operating keys



Use the **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 11.1).

The **Function keys** may assume different functions according to the menu being active. Their current properties are displayed in the line upper to the Function keys.

---

The **command and navigation key block** may also assume different functions:

- Press OK to confirm settings, store values or select menu items.
- Press ESC to abort actions or quit submenus.
- Use ARROW keys to navigate through the menu or change settings.
- If the alphanumerical block has been activated, OK and ESC keys will also assume navigation functions.

The Function keys and the command and navigation key block may be backlit on request. This adds additional comfort in poor light conditions (for more details please refer to section 10.5.2). Most screens dispose of a **“Help” Function key** for calling the context-oriented on-line “Help“. Press the “Help” Function key on the left to call the direct help.

### 3.1.3 Sockets and interfaces



The sensor socket connects to all sensor of the MiniTest 7 series using the measuring principles as described under section 1.1.

The multi-purpose socket is used for connecting the plug-in mains unit, the foot switch, an alarm device, the RS232 interface cable, USB interface cable, headphones or the multi-purpose connection box (see sections 10.5.4 and 12).

---

### 3.1.4 Power supply


#### 3.1.4.1 Batteries and storage batteries

The MiniTest 7400 is powered by a set of four alkaline-manganese cells, 1.5V, AA LR6 size (Batteries included in the standard supply schedule).

As an alternative, it may be operated on rechargeable NiMH storage batteries (type AA-HR6 or via a plug-in mains unit (available as an option). Please use only products as recommended by ElektroPhysik. Please also refer to section 14.4 “Accessories”.

If you wish to use the storage batteries, they must be recharged using the external charger unit (available as an option). Please also refer to section 13.1 “Care and maintenance” for more details.

#### Note:

- Remove batteries or storage batteries from the instrument if you are not going to use them for a longer period of time.
- The battery symbol  indicates the battery state in 6 stages: (0, 20, 40,...100%).
- If the lowest stage has been reached, “Battery almost empty” will be indicated.
- In case of total discharge “Battery too low” will be indicated and the gauge will switch off.
- Make sure to replace empty batteries within a period of about one minute. If the gauge remains longer without supply, date and time setting will go lost. If this time interval has been exceeded “Check clock setting” is shown once you have inserted fresh batteries (see also section 10.6.3). Measuring series and calibration values, however, will be kept saved in memory.
- For field use, replacement batteries should be made available.
- Erratic readings due to low battery voltage do not occur. If voltage is too low, the gauge switches off or will not switch on.
- Used or defective batteries or storage batteries may contain hazardous substances and must be disposed according to the legal provisions of your country.

---

### 3.1.4.2 Plug-in mains unit

For mains operation, the plug-in mains unit must be used. If operated via the plug-in mains unit, batteries should be inserted to supply the internal time clock, otherwise, after approx. 1 minute, the settings of the real-time clock will go lost once the mains supply is cut.

The plug-in mains unit comes with two different adapter plug versions (Euro and US plug). If the plug-in mains unit comes with an adapter plug not matching to your socket, simply change the adapter plug accordingly.

Simply remove the adapter from the plug-in mains unit and fix the other one as required.

#### **Note:**

The adapter is not designed for frequent change.

---

## 3.2 Sensor

### 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 a sensor cable– because with SIDSP® there is no measuring signal transmission taking place via the sensor 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.

The digital signal processing ensures to prevent signal noise (as occurring in any measuring procedure) so as to obtain disturbance-free measuring signals. As a result, the variations of readings are very small (unachievable with analogue procedures) and readings are extremely accurate. The best results can be obtained by using the measuring stand. The measuring stand ensured readings are taken at exactly the same spot. If readings are taken always at the same spot, almost any variations can be excluded. Take a set of 10 readings at the same measuring point and the results will almost be identical. Even in the manual mode without using the stand, repeatability and accuracy are extremely good, unmatched by analogue procedures.



---

### **3.2.2 Further sensor properties**

The sensor pole is extremely wear-resistant, suitable also for hard coatings.

For this model, a range of convertible sensors are 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



**MiniTest 7400**

**Sensor: F5**

---

2.10

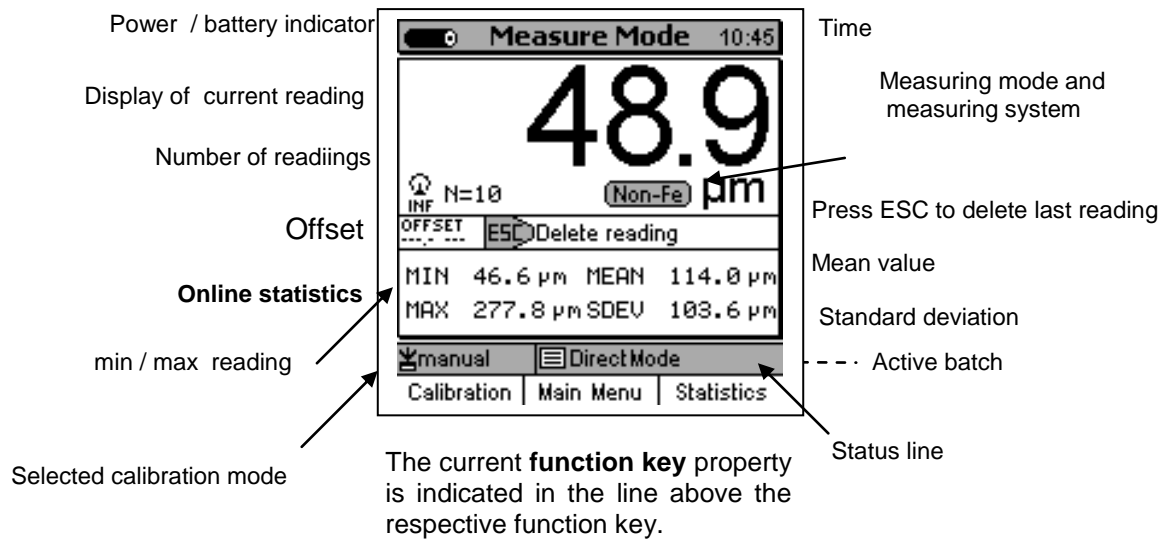
At switch-on, the start screen appears showing company logo, gauge and sensor model (if any sensor is connected).

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.
- Except for the Direct mode, you may continue a measuring series that was active before the gauge has been switched off. You will be asked whether to continue the active batch or not.

## 4.2 Screens

### 4.2.1 Measure Mode Screen / Numerical Display



### 4.2.2 Online statistics

During measurement, the online statistics is continuously updated in a separate window of the screen. See fig. above

### 4.2.3 Statistics screen

Power / battery state indicator

Time

Process capability index  
Cp and Cpk

Selected calibration mode

Current batch

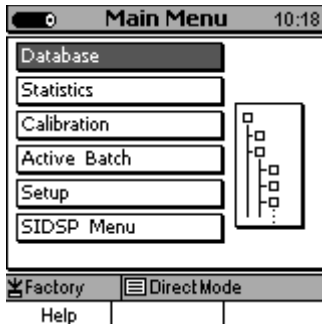
Statistics		11:07
<b>Total thickness:</b>		
Number of readings:	46	
Average:	91.00 $\mu\text{m}$	
Standard Deviation:	4.28 $\mu\text{m}$	
Minimum:	77.0 $\mu\text{m}$	
Maximum:	104.2 $\mu\text{m}$	
Variation Coefficient:	4.7 %	
Cp:	0.78	
Cpk:	0.70	
manual	Medir el punto2	
Help/Extra	Batch	Histogram

The current **function key** property is indicated in the line above the respective function key.

For further statistic screens, please refer to section 8.3.

## 4.3 User Menu

The numerous MiniTest 7400 features can be accessed via the hierarchically structured user menu. Press the Function key “**Main menu**“ in order to get access to the submenus.



Use arrow up /down keys to select an item from the Main Menu (e.g. **Statistics**) and press OK to confirm. Your selection is active.

Use arrow up/down keys in the submenu (e.g. Set-up) to select a parameter, e.g. “date / time”. Press OK to confirm or ESC to go back to the previous menu.

Depending on the submenu you have selected you can

- view settings (e.g. Gauge specs = Gauge specifications)
- select pre-set parameters (e.g. 100% brightness from the display Menu)
- Make numerical or alphanumerical entries (e.g. Enter a directory name in the database / new directory option).

### 4.3.1 User Preferences

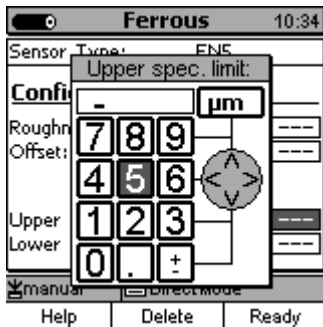


Use the arrow keys up /down to select your requested menu item, e.g. **Language**. Press OK to confirm. Your selection will be highlighted.

Use the arrows to scroll through the parameter options.

Press OK to confirm your selection (e.g. “English”) or ESC to quit without changing the parameter setting.

### 4.3.2 Numerical Entries



In some menus you have the option to make numerical entries. In the entry field, you can enter a value and the measuring system (e.g.  $\mu\text{m}$ ). Once the alphanumeric block has been activated, ESC and OK will assume navigation functions to the left or right. To make an entry, move the cursor to the character as requested. After a certain period of time, the character where the cursor has been placed will be automatically accepted without the need to confirm. You can specify the “entry accept time” under “User Preferences” in the “Entry accepted” option. See also section 10.5.5 for further reference. Complete your entry by pressing Function key “**Ready**” and then confirm “Save changes?” by pressing **OK** or press ESC if you do not want to save the changes.

### 4.3.3 Alphanumerical Entries (on MiniTest 7400)



For alphanumerical entries you can use as many as 15 characters for entering a name. ESC and OK assume navigation functions to the left or right. To make an entry, move the cursor to the character as requested. After a certain period of time, the character where the cursor has been placed will be automatically accepted without the need to confirm. You can specify the “entry accept time” under “User Preferences” in the “Entry accepted” option. See also section 10.5.5 for further reference. Complete your entry by pressing Function key “**Ready**” and then confirm “Save changes?” by pressing **OK** or press ESC if you do not want to save the changes.

---

## **5. Measure Mode**

### **5.1 Important Notes on Thickness Measurement**

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

- Selection of a measuring device suitable for his application
- Fundamentals on the electromagnetic measuring principles
- Influences through magnetic and surrounding fields
- Influence of the material surface properties (roughness, build-up on the surface)
- Methods of statistical evaluation of a measuring series

#### **5.1.1 How to interpret readings**

It is important to note that the information obtained by measurement only apply to those parts of the measuring object that have been scanned by the sensor. Be careful to draw conclusions on other parts of the measuring objects. As a rule, such conclusions should solely be made if comprehensive experience and approved methods of statistical data acquisition have been made available previously.

### **5.2 Settings to make before measurement**

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

#### **5.2.1 Batch**

With the MiniTest 7400, readings are lumped together in batches.

A batch must be created and named in the database. This name is shown on the measuring screen. If you take readings, these are stored in the currently active batch. If you switch the gauge

---

off, the last used batch name will be registered. So you can continue with this batch if you switch the gauge on again. Please note this is not possible in “Direct mode”.

A batch provides the following options:

- continue to take readings in the active batch
- create a new batch in the Database (see section 7.2.4)
- choose an existing batch from the database (see section 7.2.5).

### **5.2.2 Calibration**

The sensors of the MiniTest 7400 series may be calibrated according to your measuring task. Measuring accuracy highly depends on the calibration method.

The following calibration methods are available (see also section 6.2)

1. Factory setting
  
2. Manual calibration methods:
  - Zero calibration
  - Multi-point calibration (Zero + 1 to 4 calibration points)
  
3. Preset calibration and operating methods:
  - SSPC-PA2
  - Australian
  - Swedish
  - ISO
  - Roughness
  - PSPC



---

## 5.3 Taking readings

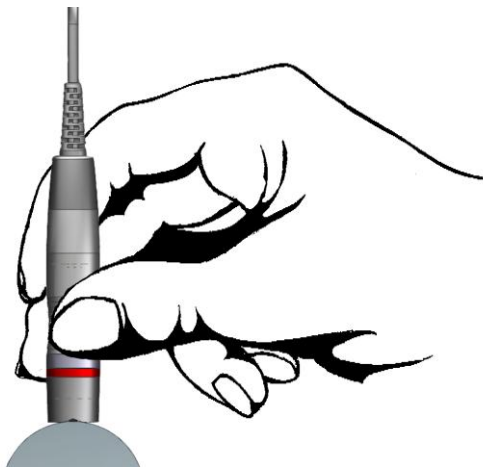
### 5.3.1 Taking readings without using the sensor stand

All sensor systems are spring-mounted to ensure a safe contact pressure on the measuring object without tilting of the probe. According sensor type, the spring is externally or internally mounted. The V-groove of the sensor ensures correct positioning of the sensor on cylindrical objects.

To take a reading, place the sensor onto the object to be measured. As soon as the sensor has been placed onto the object, a thickness reading will be shown. In the "Single readings mode", the reading will be stored into the statistics. Lift the sensor briefly to take the next reading.

In the „Scan mode“, readings are displayed continuously as long as the sensor is placed on the object. Press OK to store the currently shown reading into the statistics.

Please avoid scratching the sensor over the object to be measured in order to prevent wear-and-tear of the sensor pole. As with all precision measurement gauges, accuracy of reading will be impaired through if the sensor pole is worn. Any scratches or other damages of the sensor must be avoided. For that reason, it is recommended to place the sensor down in vertical position and hold it without moving. Remove in vertical position once the reading has been taken.



---

### 5.3.2 High-precision measuring 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.



### 5.3.3 Measurement of double-layer coatings

To improve corrosion protection and for design reasons it is common practice to apply multi-layer coatings on steel, e.g. to put zinc plus paint on steel. For this kind of application, ElektroPhysik has designed the FN 1.5 and FN 5 sensors able to measure both, the total thickness as well as the single layer thickness. If you adjust the substrate to “Ferrous”, the total thickness of layers is measured with the ferrous substrate as a reference. If you adjust the substrate to “Non-Ferrous”, the gauge will measure against the zinc layer to give you the thickness of paint. Calculate the difference between total layer and paint to get the thickness of the zinc layer.

Adjust the gauge to “Non-ferrous” and check “Zero” at a zinc-coated sample without any paint layer being applied. Measurement should take place at the same point as with the later zinc-paint coated object. Once you get an evenly spread zero point (benchmark: FN 1.5 ± 2µm; FN5 ± 3µm), the double-layer measurement will be reliable. This kind of double-layer measurement requires a **minimum zinc layer of 70 µm**.

Another option to check whether your application is suitable for this kind of double-layer measurement is to use a high-precision calibration standard. Carry out a zero-point calibration (section 6.2.2.1) or a two-point calibration (section 6.2.2.2) in the “Non-Ferrous” setting on a zinced sample (no paint applied). Choose a precision calibration standard with a thickness similar to the later thickness to be expected. Position it on the zinced sample at the same measuring spots as with the later zinc-painted object. Take a set of 1 to 3 readings at each spot. If measurement calculation is within the specified tolerance, your application is suitable for double-layer measurement with the gauge.

**Coating Thickness**     $T = \bar{X} \pm s \pm u$

Example:

Readings:                    104.4  $\mu\text{m}$ , 107.4  $\mu\text{m}$ , 105.2  $\mu\text{m}$ , 108.8  $\mu\text{m}$ , 105  $\mu\text{m}$ ,  
108  $\mu\text{m}$ , 106  $\mu\text{m}$ , 108.2  $\mu\text{m}$ , 108.6 $\mu\text{m}$ , 107.8  $\mu\text{m}$

Mean value                     $\bar{X} = 106.94 \mu\text{m}$

Standard deviation             $s (\sigma) = \pm 1,63\mu\text{m}$

Uncertainty                     $u = \pm (0.75\% \text{ of reading} + 1\mu\text{m})^*$   
\*depending on the sensor type used for measurement and relating to the calibration standards supplied with the gauge; under laboratory conditions.

Coating thickness             $T = 106,94 \mu\text{m} \pm 1,63 \mu\text{m} \pm (0,8 \mu\text{m} + 1\mu\text{m})$   
  
**= 106.94  $\mu\text{m} \pm 3.43 \mu\text{m}$**

---

### **5.3.4 Grouping readings into blocks**

Readings are subject to random errors. These may be caused by rough surfaces as they commonly occur on shot-blasted surfaces. Readings may vary according to the position of sensor in relation to the peaks and valleys of the rough surface. Increasing the number of readings can compensate this random error. This is where grouping of readings will take place.

With MiniTest 7400, consecutive readings are grouped into equal-sized groups (blocks). The number of single readings per block is user-adjustable from 1 to 100.

A statistic is calculated per each block. With the norm-conforming operation modes “ISO”, “SSPC”, “Swedish” and “Australian”, grouping in to block is required with the number of readings per block sometimes being predetermined.

To calculate the single readings statistics (i.e. statistics calculated from all readings of a batch), the block size must be set to 1.

Please refer to section 10.5.3 for more details on batch configuration and 8.3.1 and/or 8.3.5 for statistics with deactivated / activated grouping into blocks.

### **5.4 Error sources**

To ensure correct readings, it is vital to perform an appropriate calibration. After such calibration, readings will be accurate as long as you adhere to the conditions as specified in the sensor data sheet. Please refer also to section 6.1 Calibration “General remarks” and section 13 “Technical specifications”.

---

## 6. Calibration

### 6.1 General remarks

To meet the requirements of your application, the MiniTest 7400 sensors may be calibrated in as many as 5 points (including zero). Thanks to the predefined calibration and operating methods, the gauge supports the application norms “ISO 19840; SSPC, “Swedish”, “Australian”, “PSPC” and measurement on rough surfaces.

MiniTest 7400 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 if you are 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 can only be 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. Basically, the more the calibration sample matches to the measuring object, the more accurate will be the measuring results.
- Make sure the following properties of calibration sample and measuring object are matching:
  - curvature radius of surface
  - substrate materials (such as magnetic permeability, electrical conductivity; in the ideal way, calibration sample and measuring object should be of the same material)
  - substrate thickness
  - size of measuring area

- 
- Before starting calibration, make sure calibration spot, sensor tip and calibration sample 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 to find always the same respective calibration position, especially for measurements on small parts or measurements at edges and corners. For small parts it is recommended to use the measuring stand.
  - Keep away from strong magnetic fields during the calibration procedure.
  - The more the thickness of the calibration standard matches the thickness to be expected, the more accurate will be calibration and thus measurement.
  - 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, F15 or F35 sensors), a multi-point calibration is required. The thickness standards must be made 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 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. Any grease, oil, dust or other build-ups must be avoided. 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 fingerprint 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 fresh batteries have been inserted.

---

## 6.2 Calibration methods

According to your setting of task, you may use different calibration methods. Measuring accuracy depends on the calibration method you have selected. For more details please refer to section 14.2 “Sensor Specifications”

### 6.2.1 Factory calibration

The status line shows “Factory“.

In this operating mode, the characteristics and characteristic curve of the sensor are used without considering the requirements of your individual application.

Under certain circumstances (on even surfaces, standard substrates, large measuring surfaces), the “Factory” setting may provide sufficiently good results. However, before any measurement is taken, the actually obtainable accuracy should be determined for each individual case by means of an uncoated calibration sample or a coated sample of a know coating thickness. If variations are exceeding tolerance, it is necessary to calibrate for the individual application.

The factory calibration is suitable for quick and easy measurement if a medium accuracy is sufficient.

The “Factory” setting is valid until you adjust and/or perform another calibration method.

### 6.2.2 Manual calibration method

#### 6.2.2.1 Zero calibration

”Manual” 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**

”Manual” is shown in the status line.

Calibration points: zero point (directly on the substrate material) and on one 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. The thickness of the calibration standard should match the coating thickness of the later measuring object.

Compared to the zero calibration, this calibration method provides 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**

”Manual” is shown in the status line.

Calibration points: zero point (directly on the substrate material) and a set of 2-4 precision standards.

Calibration is to be made on an uncoated calibration sample of the same geometry and material as the later measuring object. Take a set of 3-5 calibration points - one directly on the substrate to give you the zero point, and two the other ones on the precision standards that you put on the substrate. In the ideal case, the thickness values of the precision standards should be evenly distributed over the thickness to be expected.

This calibration method should be recommended if you take readings over a wide range with a high accuracy being required.

### **6.2.2.4 Two-point calibration without zero point**

”Manual” 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. Take a set of 2 calibration points on 2 precision standards that have been 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. Do not take any zero point on the uncoated sample.

This specific calibration method should be for rough surfaces. Taking zero point on rough surfaces would imply strong deviations due to the uneven surface. In this calibration method, a zero point is not taken, as this would impair accuracy.

## **6.2.3 Pre-defined and menu-guided calibration methods**

### **6.2.3.1 General remarks**

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

The selection of a pre-defined calibration method is made during set-up of a batch. If you have set-up your batch via the configuration wizard, the gauge will proceed on the menu-guided calibration once set-up is finished. As long as the calibration procedure hasn't been completed, only the previously made calibration points are active. During a running calibration procedure "CAL" and the adjusted calibration mode are flashing up alternately.

### **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. Take a set of 3 calibration points: zero point (directly on the substrate) and two on precision standards that you have 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 your 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 neither the roughness value is not known and nor an uncoated sample is available, a correction value of "25 microns" should be used.

---

The number of readings should be adapted to the size of measuring area. It is recommended to take a minimum of 5 readings.

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.

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

### **6.2.3.3 Calibration method „rough“**

“Rough” is shown on the status line.

Calibration points: on two precision standards (no zero point)

This calibration method is used for rough surfaces such as shot-blasted samples.

Two calibration points are to be taken on two precision standards that you have 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. Do not take any zero point on the uncoated sample.

To achieve a maximum adaptation to the surface roughness of sample, several precision standards (50 µm max. thickness each) can be placed one on top of the 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 and the gauge calculates the average thickness.

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

“Swedish” 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 that 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. Do not take a zero point on the uncoated sample.

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

### 6.2.3.5 Calibration method “Australian”

“Australian” is shown on 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 thickness of the precision standard should match the thickness of the later object to be measured.

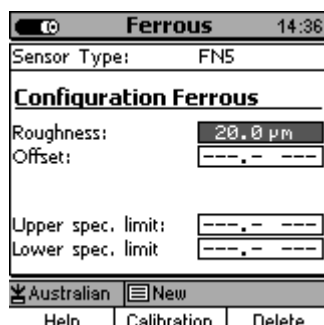
The block statistics is predefined to a minimum of 3 readings per block.

Please note:

- 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 is easy to access, a two-point calibration as described under section 6.4.3.3 should be made on the uncoated, smooth (non-blasted) calibration sample. Make sure the came is clean and has got the same shape and is made of the same material as the later measuring object.

After this, take at least 10 readings on the rough (blasted) and uncoated measuring object. Enter the roughness average (mean value  $\bar{x}$ ) to configure your batch. This value will be automatically subtracted from the thickness reading. The result will give you the coating thickness over the peaks.

- If there is no access to the uncoated rough substrate, the parameter “Roughness” must be set to 1/3 of the expected profile height. Example: If the roughness value of your sample is 60 microns, you have to set “Roughness” to 20microns ( $60 \times 1/3 = 20$ ).



---

### 6.2.3.6 Calibration according to SSPC-PA2

“SSPC” is shown in the status line.

This method applies for rough substrates such as shot-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 on precision standards.

Calibration is made on an uncoated, smooth (non-shot blasted) sample. The sample should have the same geometry and substrate material as the later object to be measured (please refer to section 6.2.2.4 Multi-point calibration).

The block statistics pre-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.

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.

### 6.2.3.7 Calibration according to PSPC

“PSPC” is shown on the status line.

The “PSPC” mode is made for taking readings according to 90/10 IMO MSC.215 (82). You comply with 90/10 criteria if 90% of readings  $\geq$  NDFT (Nominal Dry Film Thickness) and if none of the remaining 10% of readings are  $< 0.9 \times$  NDFT.

---

According to IMO MSC.215 (82), for epoxy resin painting, NDFT = 320 µm (other painting systems according to manufacturer specifications). According to 90/10 criteria, 90% of readings must be  $\geq 320$  µm and no reading must be  $< 0.9 \times 320$  µm = 288 µm.

A manual calibration is preset with the calibration on zero point (directly on the substrate) and two precision standards,

## 6.3 Shot-blasted and rough surfaces

### 6.3.1 General remarks

To remove rust in order to ensure a good adhesion of the paint, a steel surface is commonly pre-treated by shot blasting. As a result, the base material will roughen. However, roughness impairing accuracy, i.e. the readings obtained on such samples will be higher compared to the actual thickness.

The following section describes how to eliminate the influence of roughness on the accuracy of coating thickness measurement.

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

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 one precision standard.

- Carry out a two point-calibration according to section 6.4.3.3. Use a smooth (non shot-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 (shot-blasted) sample. Calculate the average. Enter this value in the "Roughness" setting of your batch.
- The roughness value you have entered will be automatically subtracted from the thickness value to give you the thickness value over the peaks. Make sure to take a set of at least 10 readings on the coated and rough (shot-blasted) sample.

---

### 6.3.3 Method B (Roughness Rz < 20µm)

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

Calibration points: zero point and one precision standard.

- Carry out a two point-calibration according to section 6.4 3.3. Use an uncoated, rough (shot-blasted) and clean calibration sample. It should have the same geometry and be of the same substrate material as the later measuring object.
- Take at least 10 readings on the uncoated calibration sample followed by 10 readings on the precision standard. To achieve a maximum adaptation to the surface roughness of sample, several precision standards (50 µm max. thickness each) can be placed one on top of the other. Thin precision standards are more flexible than thick ones and thus better adapt to uneven surfaces. The calibration value should roughly match the coating thickness to be expected.

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

### 6.3.4 Method C

- For calibration, use two precision standards of a different thickness. This method is the two-point calibration without zero point according to section 6.4.3.5. Also this method will provide reliable results.
- 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 in such cases.

## 6.4 How to calibrate

### 6.4.1 General remarks

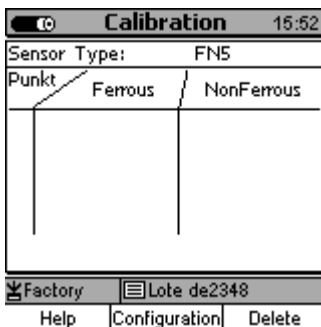
For all calibration methods the following applies:

- 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 setting the following applies:

- For optimum calibration accuracy it is recommended to take a set of 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 any more. However, it is possible to recalibrate each individual calibration (in the mode that has been used when creating the batch).

### 6.4.2 Factory Setting

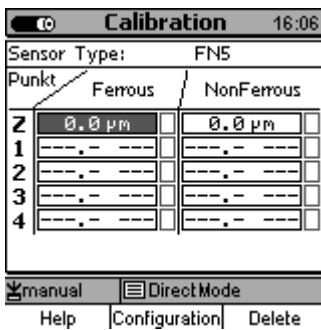


If calibration is set to “Factory”, you can start to take readings immediately after your batch has been created and set up.

### 6.4.3 Manual calibration

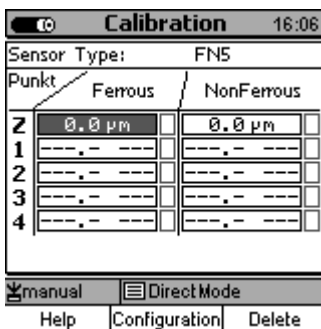
In measure mode, press function key CAL to call the calibration mode. The calibration menu will appear automatically after you have completed the configuration of a batch via the configuration wizard.

#### 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, ferrous and non-ferrous bases. Select the base for which you wish to calibrate first. 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, The calibration table will appear again. Now chose the next base to be calibrated. Use arrow up/down keys to make your selection and press OK to confirm. Perform calibration accordingly. If calibration 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

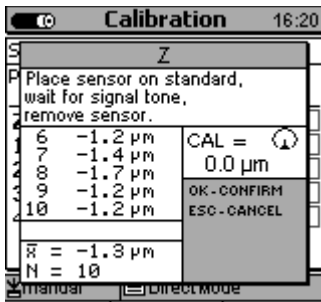


In measure mode, press function key “Calibration” to call the calibration menu.

Choose the base and calibration point you wish to calibrate first.

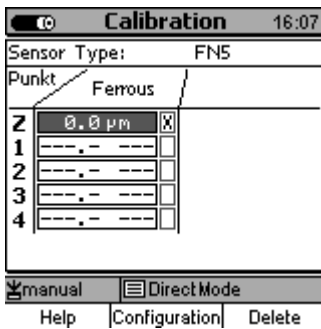
Use arrow up/down keys to make your selection and press OK to confirm.





After launching the calibration procedure, place the sensor onto the uncoated calibration sample. Wait for the signal tone indicating the reading has been taken and remove sensor. Please see also section 6.1 General remarks.

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



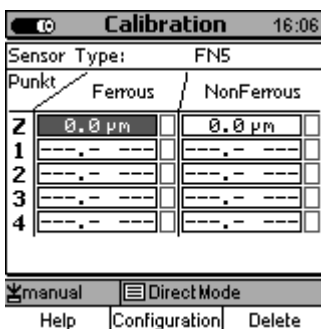
You can check the calibration values for each point on the list as shown on the left. Press ESC to go back to the measuring mode.

If an FN sensor is connected please do also calibrate for the other base material.

Once you have completed a calibration point, the box behind this point will be ticked (X).

### 6.4.3.3 Two-point calibration

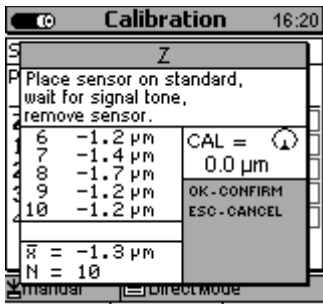
In measure mode, press function key "Calibration" to call the calibration menu.



Select the base and calibration point you wish to calibrate for.

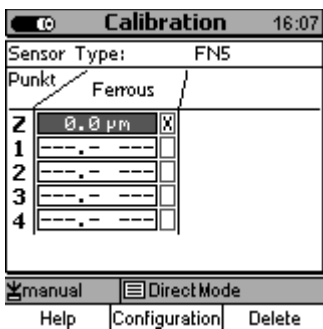
Use arrow up/down keys to make your selection.

Press OK to confirm.

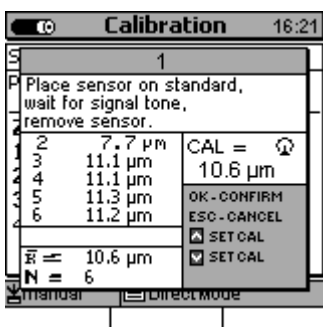


After launching the calibration procedure, place the sensor onto the uncoated calibration sample. Wait for the signal tone indicating the reading has been taken and remove sensor. Please see also section 61 General remarks.

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

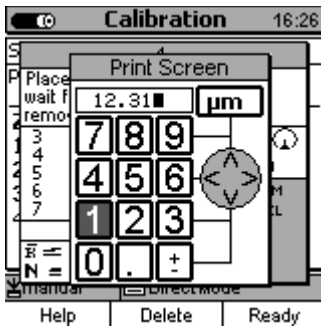


Once you have completed a calibration point, you can check the calibration points on the table. Select the next calibration point and confirm by OK.



Put the sensor onto the uncoated calibration sample. The thickness of the calibration sample should match the coating thickness of your later measuring sample. Wait for the signal tone to sound and remove sensor. Repeat this procedure several times (approx. 3 to 10 times) on the same measuring spot.

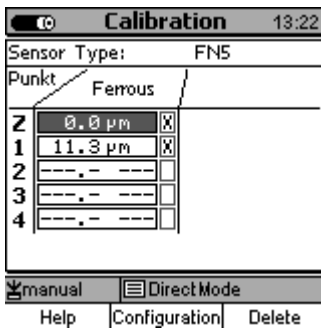
Under CAL, the current average will be shown as calculated from the set of calibration values you have taken. If this point has been calibrated previously, this previous value will be shown.



If the calibration average matches the thickness of your precision standard, press OK to complete calibration.

If the calibration average does not match the thickness of your precision standard, use arrow up/down keys to correct the value accordingly via the numerical block.

You can enter the thickness value and the measuring system ( $\mu\text{m}$ , mm, etc.) via the numerical block. Use ESC to go to the left and OK to go to the right. Your entry will be accepted automatically after a certain “entry accepted” time. This time can be specified under Main menu / Set-up/User preferences / Entry accepted. See section 10.5.5. Confirm your setting by pressing “Ready”.



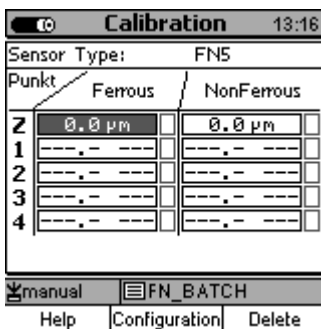
You can check the calibration values for each point on the list as shown on the left. Press ESC to go back to the measuring mode.

If an FN sensor is connected please do also calibrate for the other base material.

Once you have completed a calibration point, the box behind this point will be ticked (X).

#### 6.4.3.4 Multi-point calibration

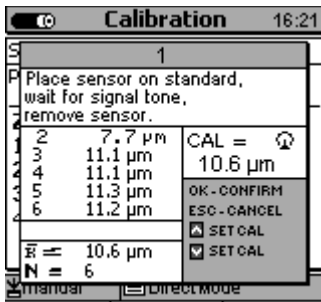
In measure mode, press function key “Calibration” to call the calibration menu.



Select the base and calibration point you wish to calibrate for.

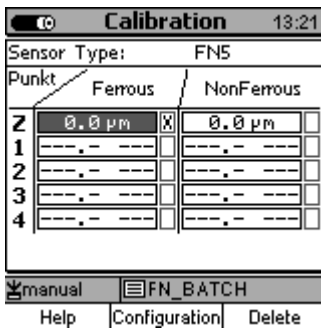
Use arrow up/down keys to make your selection.

Press OK to confirm.

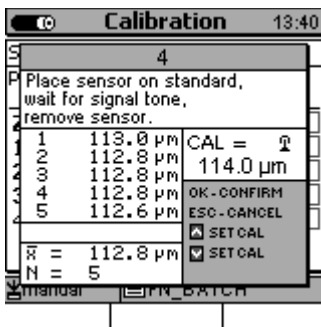


After launching the calibration procedure, place the sensor onto the uncoated calibration sample. Wait for the signal tone indicating the reading has been taken and remove sensor. Please see also section 61 General remarks.

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



Once you have completed a calibration point, you can check the calibration points on the table. Select the next calibration point and confirm by OK.

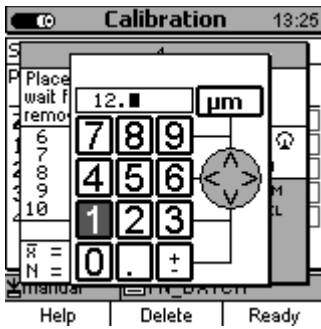


Put the sensor onto the uncoated calibration sample. Wait for the signal tone to sound and remove sensor. Repeat this procedure several times (approx. 3 to 10 times) on the same measuring spot.

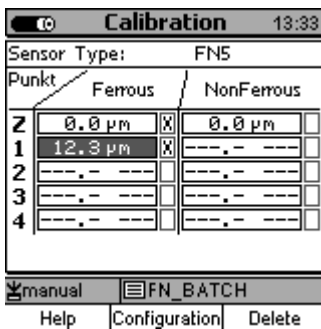
Under CAL, the current average will be shown as calculated from the set of calibration values you have taken. If this point has been calibrated previously, this previous value will be shown.

If the calibration average matches the thickness of you precision standard, press OK to complete calibration.

If the calibration average does not match the thickness of you precision standard, use arrow up/down keys to correct the value accordingly via the numerical block.

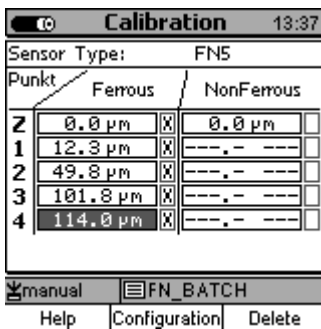


You can enter the thickness value and the measuring system ( $\mu\text{m}$ , mm, etc.) via the numerical block. Use ESC to go to the left and OK to go to the right. Your entry will be accepted automatically after a certain “entry accepted” time. This time can be specified under Main menu / Set-up/User preferences / Entry accepted. See section 10.5.5. Confirm your setting by pressing “Ready”.



You can check the calibration values for each point on the list as shown on the left. Select the next calibration point and confirm by pressing OK:

Proceed as above for taking further calibration points.



Refer to the calibration table to get an overview on the calibrated points. Once a calibration point has been completed, the box behind the calibration point will be ticked.

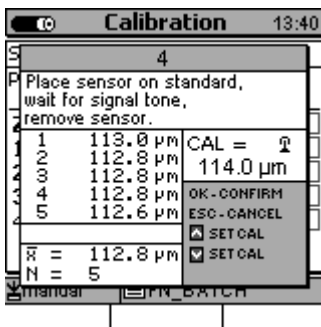
After you have completed the last calibration point you can directly proceed on measurement. Press ESC to go back to the measuring mode.

### 6.4.3.5 Two-point calibration without zero

In measure mode, press function key “Calibration” to call the calibration menu.

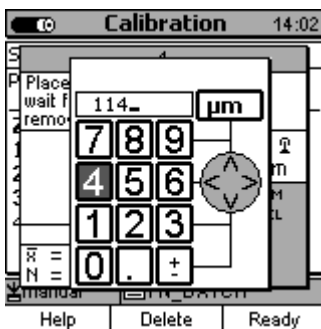


After launching the calibration procedure, the calibration table is shown. Use arrow up/down keys to select the first calibration point. Press OK to confirm.

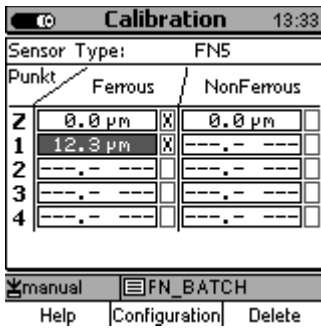


Place the first precision standard on the uncoated calibration sample. Place the sensor on the precision standard, wait for the signal to sound and lift the sensor. Repeat this procedure several times (approx. 3 to 10 times) on the same measuring spot.

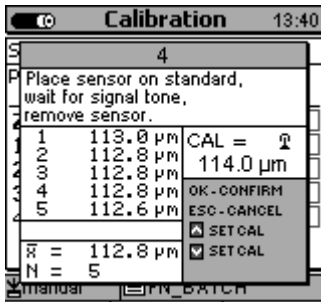
In the CAL field the average as calculated from the single readings is shown. If this point has been calibrated previously, this previous calibration value will be shown. If the value matches the thickness of your calibration standard, press OK to confirm and complete calibration. If the value does not match your precision standard, use arrow up/down keys to correct accordingly.



You can enter the thickness value and the measuring system (µm, mm, etc.) via the numerical block. Use ESC to go to the left and OK to go to the right. Your entry will be accepted automatically after a certain “entry accepted” time. This time can be specified under Main menu/Set-up/User preferences/Entry accepted. See section 10.5.5. Confirm your setting by pressing “Ready”.

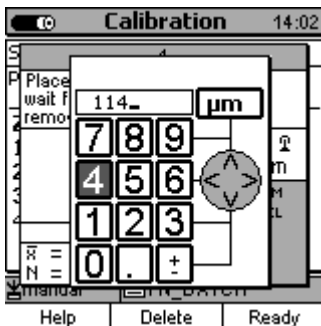


After launching the calibration procedure, the calibration table is shown. Use arrow up/down keys to select the 2nd calibration point. Press OK to confirm.

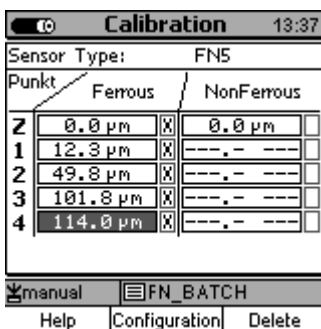


Place the first precision standard on the uncoated calibration sample. Place the sensor on the precision standard, wait for the signal to sound and lift the sensor. Repeat this procedure several times (approx. 3 to 10 times) on the same measuring spot.

In the CAL field the average as calculated from the single readings is shown. If this point has been calibrated previously, this previous calibration value will be shown. If the value matches the thickness of your calibration standard, press OK to confirm and complete calibration. If the value does not match your precision standard, use arrow up/down keys to correct accordingly.



Press OK to save the calibration value.



On the calibration table you can check the progress of the calibration procedure. If a calibration point has been completed, the box behind this point is ticked.

After the last calibration point has been complete, you can proceed on taking readings. Press ESC to go to the measuring mode.

## 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. See also section 6.4.1.



If you start the recalibration procedure at the zero point, the warning as shown on the left will be shown.

If you change the zero value you'll have to check and correct the other calibration values if necessary.

Press OK to confirm you have noted the warning and go through the calibration procedure as usual.

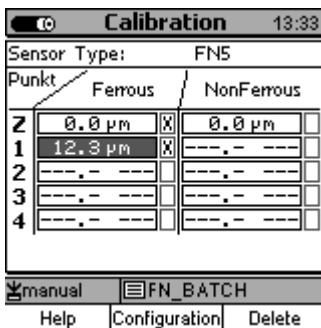
Press ESC if you do not wish to change the zero point and to go back to the calibration table.

If you do not take a new zero point but skip this point, the warning will disappear and you can change the other calibration values as required.

## 6.6 Interrupt or abort a calibration procedure

You can interrupt or abort a current calibration procedure by pressing ESC.

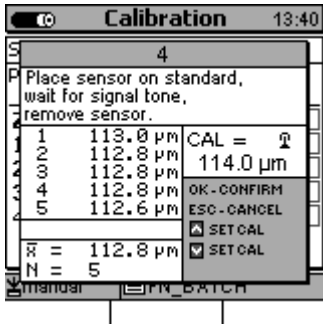
According to the current action, this may result in two different reactions:



1st: No calibration value has been taken so far.

If you press ESC, the gauge goes back to the measuring mode. The currently stored calibration will continue to be active.





2nd situation: You have taken at least one calibration value for a calibration point but you haven't completed this calibration point, i. e. you have not yet press OK to confirm and save the value.

If you press ESC, the gauge goes back to the calibration table. the currently stored calibration will continue to be active.

## 6.7 Delete a calibration point

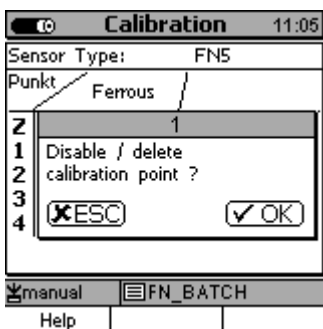
Use arrow up/down keys to select the calibration point you wish to delete. Press ESC to abort.

Once "Delete" is pressed, the box behind the relevant calibration point will untick. The calibration point has been deleted. However, the calibration value will remain in the table and can be used for a recalibration of this point if of the same thickness. If you press "Delete" a second time, also the calibration value will be deleted. The whole calibration value will be removed from the table. To recalibrate this point, you have to create a new calibration point and calibrate it accordingly by means of a suitable calibration thickness value.

After deletion, the remaining calibration points will be renumbered. 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.



After completion of the calibration procedure, you may delete Individual calibration points or the complete calibration.

Use arrow up/down keys and press ESC to delete. First you will be asked whether you are sure about the deletion. Press OK to delete or ESC to abort.

After you have deleted individual calibration points, the list will be renumbered. Example: If you delete point 1, point 2 will be renumbered to point 1.

Please note: The readings of the batch will be kept in memory no matter whether you have deleted individual calibration points or the whole calibration.

---

## **7. Data management**

### **7.1 Batches**

#### **7.1.1 General remarks**

In the MiniTest 7400, relating data such as readings, calibration values, statistics and setting parameters are stored in data sets called “batches”. As a consequence, all readings of a batch are relating to the calibration as defined for this special batch. Also the setting parameters and the statistics are batch-related. Once you open a batch, the calibration and parameters settings as stored for this batch will be enabled.

To create a batch, select Main menu / Database. The tree-structured directory provides a quick overview. A predefined batch is stored under the name “Direct Mode”. This batch can neither be deleted nor renamed. Use this batch for quick and rough readings if there is no need for data storage or data evaluation. Batches and directories can be defined alphanumerically.

#### **7.1.2 Memory capacity and structure**

The memory of MiniTest 7400 is divided into 500 batches to store a maximum of 250,000 readings. The PC liked file manager facilitates data management by user-definable file naming and creation of directories and folders.

A directory may present up to 5 levels to store a maximum of 500 batches. How the memory is divided up is user-definable. As an example, you can see the complete memory for one single batch. The batch size will be according to your requirements, i.e. it is not necessary to predefine the batch size.

#### **7.1.3 Setting parameters**

A batch is defined by parameters such as “calibration methods”, “substrate”, “measuring mode”, “roughness”, “offset”, “block size”, “upper limit” and “lower limit.

According to calibration method, not all parameters will be available. Please refer to the table of parameters as below.

Once you activate a batch that has been configured previously, the parameters as set for this batch will be enabled.

Basically, a batch is relating to the sensor that was connected while the batch has been created. Make sure to have the correct sensor connected before you select a batch containing stored readings.

If you connect an inappropriate sensor, a warning will appear on display. In addition, you will neither be able to make certain changes to this batch or take readings.

Example: It is impossible to continue a batch that has been defined for an FN5 sensor if an FN 1.5 sensor is connected (even if this sensor would determine the thickness reliably).

### Table of Setting parameters

Calibration method Parameter	Factory presetting	manual	ISO	SSPC	rough	Australian	Swedish	PSPC
Measuring mode	x	x	x	x	x	x	x	x
Roughness	x	x	x	x	-	-	x	x
Offset	x	x	x	x	x	x	x	x
Block size	-	1-100	5-100	3-100	1-100	3-100	5-100	1-100
Upper limit	x	x	x	x	x	x	x	x
Lower limit	x	x	x	x	x	x	x	x
Symbol in status line	<b>Factory</b>	<b>Manual</b>	<b>ISO</b>	<b>SSPC</b>	<b>Rough</b>	<b>Australian</b>	<b>Swedish</b>	<b>PSPC</b>
Auto-FN-mode	x	x	-	-	-	-	-	-

## 7.2 Database

### 7.2.1 General remarks



The Database facilitates data management.

Total capacity of Database: 500 measuring series

Number of directory levels per measuring series: 5

Call the Database to

- create and define batches
- select a file to take or continue measurements or
- call statistics and other batch data

### 7.2.2 Create a directory



Press function key “Main menu” and select “Database”. Press OK to confirm. The Database structure appears.

Use arrow up/down keys and move cursor to the place where you wish to create a new directory. A new directory (or batch) can be created where the flash symbol appears.

Press function key “Action”. Select “New Directory” from the list.



The alphanumerical block appears. Use navigation key to move the cursor to the requested character. Please refer also to 4.3.3 “Alphanumerical entries”.

### 7.2.3 Create a batch

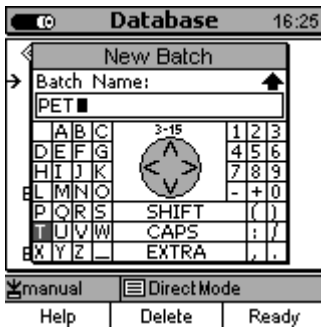
Please note: At the first switch on of the gauge or after a Total Reset, the “Direct Mode” is enabled. For this mode, the factory presetting is defined. The Direct mode is always relating to the sensor currently connected. You can start to take readings immediately.



Press function key “Main menu” and select “Database”. Press OK to confirm. The Database structure appears.

Use arrow up/down keys and move cursor to the place where you wish to create a new batch. A new batch can be created where the flash symbol appears.

Press function key “Action”. Select “New Batch” from the list.



Use the alphanumeric block to enter the batch name. Please refer also to section 4.3.3 “Alphanumerical Entries”.



After you have made the batch name input, the alphanumeric block appears again. Enter the operator name according to the same procedure as described above. See also section 4.4.3 “Alphanumerical Entries”.

The input of the user name is not compulsory and may be omitted.



If you wish to copy the settings (parameter and calibration) from the active batch press OK.

If you do not wish to copy settings to the new batch press ESC.

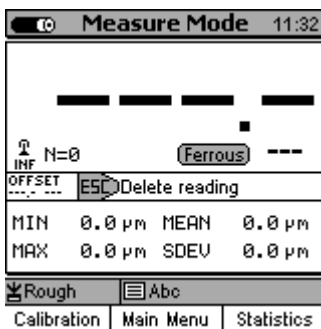
The copy parameters function facilitates the creation of a series of batches of the same kind.

Parameters and calibration settings is made via the “Configuration” menu. See section 10.5.3.

## 7.2.4 Select a measuring series

### Fehler!

Press function key Main menu.



Select “Database” and press OK to confirm.

The name of the currently active batch is shown on the status line.

Use arrow up/down keys to select requested batch.

Press OK to confirm. Your selection is active now. The batch information (as shown on the left) is shown.

If you do not wish to make any changes to the batch you can directly proceed on measurement.

Place the sensor on the measuring object to take reading. The gauge changes automatically to the measuring mode. The current reading is shown.

You may also press OK to change from the batch info window to the measuring menu.

## 7.2.5 Delete a batch or directory



**Fehler!**



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

Use arrow up/down keys to select the batch or directory you wish to delete. Press function key “Actions”.

Select “Delete” from the list. A security question appears if you are sure to delete the batch.

Press OK to delete or ESC to abort.

Only empty directories can be deleted. Any subdirectories or batches stored in the directory you wish to delete must be deleted previously.

The “Direct Mode” batch can neither be deleted nor renamed, nor can a user name be assigned. However, you may delete readings or statistics stored in the “Direct Mode” batch.

### **Caution!**

The delete action will delete the selected data irrevocably. Data cannot be restored any more.

## 7.2.6 Rename a batch or a directory

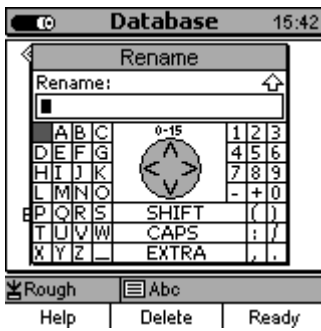


Press function key Main menu and select “Database”. Press OK to confirm.

Use arrow up/down keys to select the batch or directory you wish to delete. Press function key “Actions”.

Select “Rename” from the list.

The alphanumerical block appears. The batch name can be changed as requested. See section 4.4.3 “Alphanumerical entries”.



The user name will not be changed during this action.



## 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, printout or delete statistical values, single readings, trend diagram or histogram or transfer them to a PC. For more details on statistical terms please refer to section 15.2.

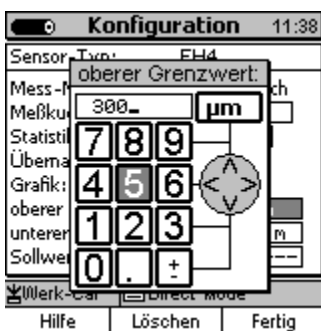
### 8.2 Parameters for statistics calculation

#### 8.2.1 Upper and lower specification limits

The upper and lower specification limits are user-adjustable.

The practical benefits of setting specification limits is as follows:

- Readings beyond the specification limits will be indicated by an audible or visual alarm and will be marked in the statistics accordingly
- The process capability indices  $cp$  and  $cpk$  will be calculated on the of the set specification limits.
- In the trend diagram and histogram, the range of readings within tolerance can be quickly identified as this range is highlighted in grey in the trend diagram and histogram.



For setting, go to the “Configuration“ menu. Enter the specification limits and the measuring system via the alphanumeric field. See also section 4.4.2. “Numerical settings”.

Press “Ready” to complete your entry. The gauge will automatically check whether you have set the limits according to the measuring range of the sensor connected. For instance, if you set a wrong measuring system you might easily exceed the range of your sensor.

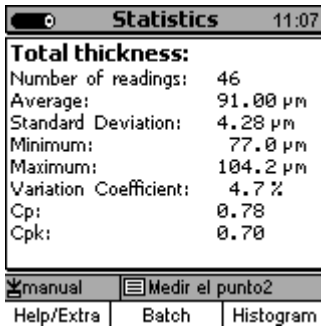
Press function key “Delete” if you wish to delete settings.

You may set the specification limits before or after measurement.

## 8.3 View statistics

### 8.3.1 View statistics if grouping into measuring blocks is disabled

This statistic is calculated over the complete measuring batch. If you have disabled grouping of readings into blocks, the statistics is calculated over the set of single readings (“Single readings statistics”).

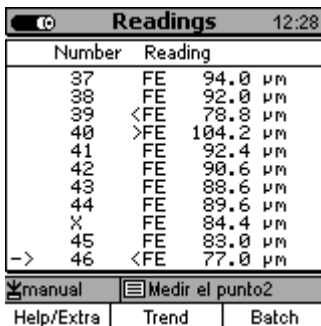


Statistics		11:07
<b>Total thickness:</b>		
Number of readings:	46	
Average:	91.00 µm	
Standard Deviation:	4.28 µm	
Minimum:	77.0 µm	
Maximum:	104.2 µm	
Variation Coefficient:	4.7 %	
Cp:	0.78	
Cpk:	0.78	
manual Medir el punto2		
Help/Extra	Batch	Histogram

In measuring mode, press function key „Statistics“ to call the statistics function.

From main menu, press “Statistics” followed by “numeric”.

### 8.3.2 View single readings



Readings			12:28
Number	Reading		
37	FE	94.0 µm	
38	FE	92.0 µm	
39	<FE	78.8 µm	
40	>FE	104.2 µm	
41	FE	92.4 µm	
42	FE	90.6 µm	
43	FE	88.6 µm	
44	FE	89.6 µm	
X	FE	84.4 µm	
45	FE	83.0 µm	
->	46	<FE	77.0 µm
manual Medir el punto2			
Help/Extra	Trend	Batch	

You have the following options to view the single readings:

- From main menu, press “Statistics” followed by “Readings”
- In the main menu press “Active batch” followed by “Readings”
- From the measuring mode press function key “Statistics” followed by “Batch” and “Readings”.

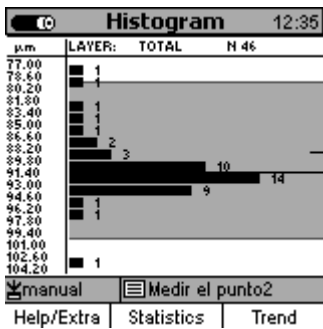
Use arrow up/down keys to scroll through the single readings list of a batch. The list includes reference number, measuring system and reading. If you have set specification limits, the single readings will be marked by “>” or “<” in case limits have been exceeded.

Readings that have been deleted will be marked by an “X”. Readings that have been deleted will not be considered for statistics calculation.

### 8.3.3 Histogram with MiniTest 7400

From Main menu press “Statistics” followed by “Histogram”.

From Measuring mode press function key “Statistics”.



In statistics, a histogram is a graphical representation showing a visual impression of the distribution of data. It is an estimate of the probability distribution of the thickness readings. The histogram helps you to decide how to change the production process in order to optimise quality.

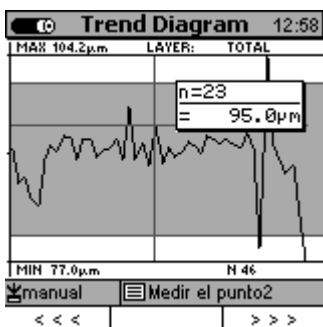
The range within the specification limits is highlighted in grey. See also section 8.1.1 “Upper and lower specification limits”.

Please note: For a histogram, at least 5 readings are required.

### 8.3.4 Trend diagram with MiniTest 7400

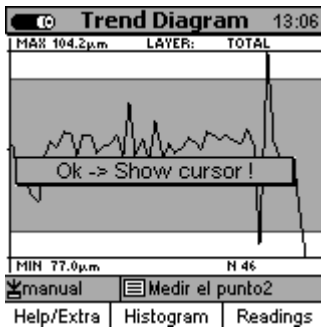
From Main menu press “Statistics” followed by “Trend”.

From Measuring mode press function key “Statistics”.



The trend diagram on the left represents the trend estimation of readings. It may be useful to determine if measurements exhibit an increasing or decreasing trend.

Please note: For a trend diagram, at least 5 readings are required.



Press OK to show the cursor.



Use function keys “<<<” and “>>>” to move through the trend diagram. The current position of the trend line shows the relating reading along with its reference number and thickness value.

### 8.3.5 View statistics if grouping into measuring blocks is enabled

This statistic is calculate over the complete range of batch. If the “group readings into blocks” has been enabled, the statistics is calculated from the set of single block statistics.



From Measuring Mode press function key “Statistic” to call the block statistics.

For the block statistic applies: “number of reading” = “number of complete blocks”.

### 8.3.6 View single readings and single block statistic

If the “group readings into blocks” function is enabled, you can view the single block statistics via the list of single readings.

You have the following options to view the single readings:

- From main menu, press “Statistics” followed by “Readings”
- From the main menu press “Active Batch” followed by “Readings”
- From the Measuring Mode press “Statistics” followed by “Batch” and “Readings”.

Readings 12:28		
Number	Reading	
37	FE	94.0 µm
38	FE	92.0 µm
39	<FE	78.8 µm
40	>FE	104.2 µm
41	FE	92.4 µm
42	FE	90.6 µm
43	FE	88.6 µm
44	FE	89.6 µm
X	FE	84.4 µm
45	FE	83.0 µm
->	<FE	77.0 µm

manual Medir el punto2  
Help/Extra Trend Batch

Use arrow up/down keys to scroll through the single readings list of a batch. The list includes reference number (first column), the relating block reference number (second column), the measuring system and reading.

If you have set specification limits, the readings will be marked by “>” or “<” in case limits have been exceeded.

Readings that have been deleted will be marked by an “X”. Readings that have been deleted will not be considered for statistics calculation.

Readings 10:18		
Number	Reading	
2/3	>FE	101.4 µm
Stats block: 6		
Average:	101.67 µm	
Standard Deviation:	0.12 µm	
Maximum:	101.8 µm	
Minimum:	101.6 µm	
OK		
3/6	>FE	101.6 µm

manual Medir el punto2  
Help

Use arrow up/down keys to move the cursor(->) to the block whose single values statistic you would like to view. Press OK to confirm. The single value statistics of the selected block appears. The statistic includes average, standard deviation, min. and max.

Readings		10:26
Number	Reading	
3/3	>FE	101.2 $\mu\text{m}$
Stats block: 7		
Average:	101.47 $\mu\text{m}$	
Standard Deviation:	0.12 $\mu\text{m}$	
Maximum:	101.6 $\mu\text{m}$	
Minimum:	101.4 $\mu\text{m}$	
<input checked="" type="checkbox"/> OK		
-> 1/7	>FE	101.6 $\mu\text{m}$
manual	Medir el punto2	
Help		

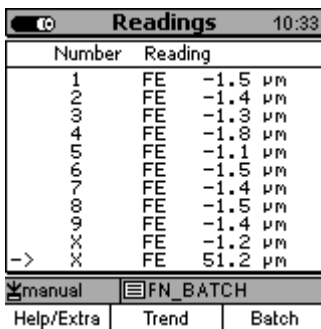
If blocks are incomplete, the single block statistic will not be shown.

Please note: only completed blocks will be considered for the statistics.

## 8.4 Delete readings of a batch

### 8.4.1 Delete single readings

Erratic readings may be deleted from the list of single readings.

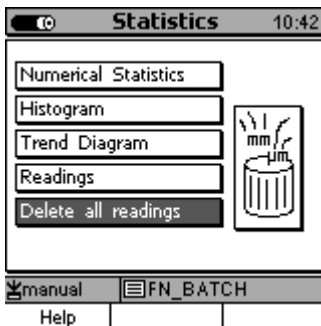


Number	Reading
1	FE -1.5 µm
2	FE -1.4 µm
3	FE -1.3 µm
4	FE -1.8 µm
5	FE -1.1 µm
6	FE -1.5 µm
7	FE -1.4 µm
8	FE -1.5 µm
9	FE -1.4 µm
X	FE -1.2 µm
-> X	FE 51.2 µm

Use arrow up/down keys to move the cursor(->) to the erratic reading you would like to delete. Press function key “Help/Extra” and select “Delete reading”. Press OK to confirm or ESC if you wish to abort.

Once you have delete a reading, it will remain on the list. However, it will be marked by on “X”. Deleted readings will neither be considered for statistics calculation nor will they be printed out or transferred to PC.

### 8.4.2 Delete all readings



Statistics
Numerical Statistics
Histogram
Trend Diagram
Readings
Delete all readings

From Main Menu select “Statistics”. Press OK to confirm. Scroll down to “Delete all readings”. Press OK to confirm or ESC to abort.

From Measure Mode press function key “Statistics” followed by “Help/Extra”. Scroll down to “Delete all readings” and press OK to confirm or ESC to abort.

The delete action will delete all readings of the active batch. However, the name of batch, the sensor configuration and calibration will persist.

### 8.4.3 Delete a current reading

In the single readings mode you may delete a current reading by pressing ESC.

The deleted reading will be marked as deleted by an “X” but it will remain on the list. A delete readings will neither be considered for statistics calculation nor will it be printed out or transferred to a PC.

In the continuous mode, the last reading may only be deleted via “Statistics” followed by “Reading”. See also section 8.3.2 “View single readings”.

## 9. Data output / Data transfer

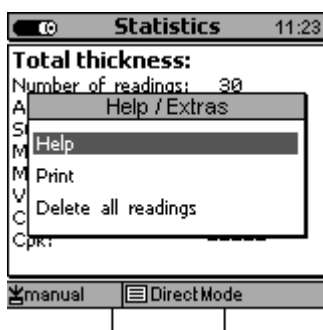
Readings and statistics of a batch can be transferred to a PC or printed-out on the data printer MiniPrint 7000. MiniPrint 7000 is available as an option.

MiniTest 7400 is equipped with two data ports:

- RS 232 interface
- Infrared (IrDA®1.0)

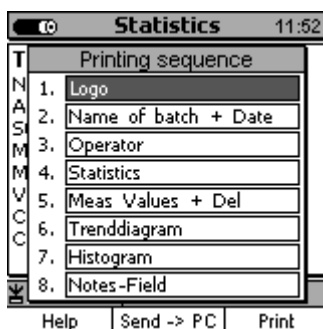
### 9.1 Print-out data

Data transfer of readings and statistics to the data printer MiniPrint 7000 is made via the IR interface (IrDA® 1.0). Before print-out make sure to adjust the gauge the IR interface. From Main Menu go to “Setup” and select “Data Output”. Set to “Infrared (IrDA)”. See also section 10.5.4.2.



Readings and statistics can be printed out from all statistics screens such as “Statistics”, “Batches”, “Readings”, “Histogram” or “Trend”. Press function key “Help/Extra” from any of these screens.

Select “Print” and press OK to confirm.



The “Printing Sequence” window will open.

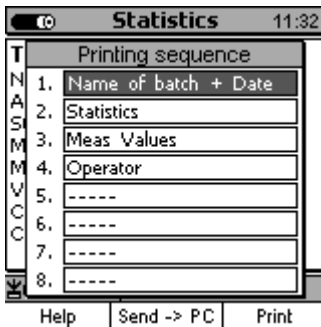
You may select and adjust items 1 to 9 according to your requirements.

The sequence is also user-adjustable.

1. Company logo (either ElektroPhysik (gauge manufacturer) or your own company logo. To include 160 x 80 pixel graphics format ask for additional software available as an option)
2. Name of batch / name of batch + date
3. Operator
4. Statistics (number of readings, average ( $\bar{x}$ ), standard deviation (s), minimum, maximum, variation coefficient, capability indices cp und cpk).



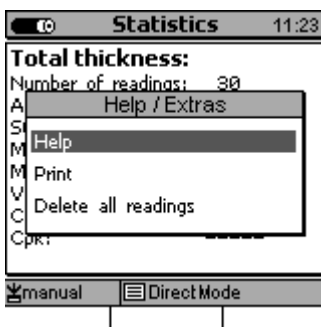
5. / Measuring values / Measuring values + deleted values (see section 8.2.2)
6. Trend diagram
7. Histogram
8. Notes-field (5 lines for remarks)
9. ---- (field remains empty)



You may omit items as requested.

Point the IR window of MiniTest 7400 to the IR window of the MiniPrint 7000 data printer. Make sure no objects between the two windows disturb data transfer.

Press function key "Print or ESC to abort.



Readings and statistics can be printed out from all statistics screens such as "Statistics", "Batches", "Readings", "Histogram" or "Trend".

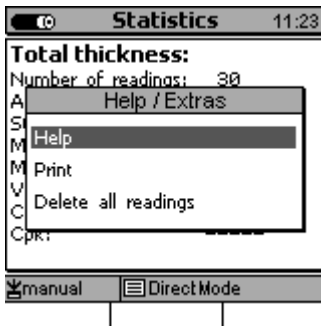
Press function key "Help/Extra" from any of these screens.

Select "Help/Extra" and press OK to confirm.

## 9.2 Transfer data to a PC (terminal program)

Before transferring data make sure to adjust the data port accordingly. From Main Menu, select "Setup" followed by "Data Output". Press OK and use arrow up/down keys to make your selection "RS232 Cable" or "Infrared IrDA). Press OK to confirm. See also section 10.5.4.

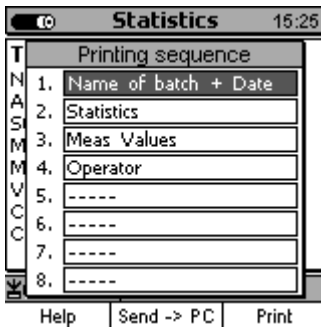
In the RS232 option make sure to set the data format (baud rate) appropriately. The "Transmission Protocoll" option must be set to "OFF". When adjusting the data output to Infrared make sure the terminal program supports "IR-COMM".



Readings and statistics can be transferred to a PC from all statistics screens such as “Statistics”, “Batches”, “Readings”, “Histogram” or “Trend”.

Press function key “Help/Extra” from any of these screens.

Select “Print” and press OK to confirm.



The “Printing Sequence“ window will open.

You may select and adjust items 1 to 5 according to your requirements.

The sequence is also user-adjustable.

1. Name of batch / Name of batch + date
2. Statistics (number or readings, average ( $\bar{x}$ ), standard deviation (s), minimum, maximum, variation coefficient cp and cpk)
3. Measuring values / Measuring values + deleted values (see section 8.2.2)
4. Operator
5. ----- (Field remains empty)

If you have set the data output to RS232, use the RS232 data cable to connect MiniPrint 7400 to your computer.

If you have set the data output to IR point the IR window of MiniTest 7400 to the IR port of you computer or IR adaptor. Make sure the data connection is not disturbed trough any objects.

Press function key “Send ->PC” to launch the data transfer or press ESC to abort.

**Please note:** AS the data transfer is made in ASCII format, graphical representations such as histogram and trend diagram will not be transferred.

After you have launched the print function, the info window “Data transfer in progress...” appears. If the communication between Infrared and printer or PC failed, an error message will appear.

---

If the “Transfer Error !! “ message appears, you have the following options:

1. Check your computer and/or printer configuration.

Check the direct visual contact between the IR windows. For data transfer, an unobstructed view between the IR devices must be ensured. If necessary, clean the IR devices using a moist cloth. Use water or a mild detergent.

### 9.3 Transfer of data to a PC (MSoft 7)

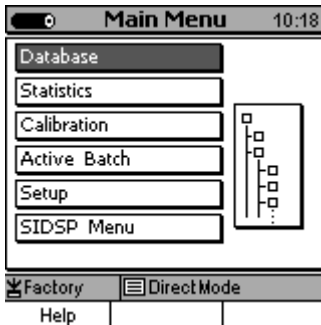
An interactive data transfer is available via the “Msoft 7“ software. This software supports both, Infrared or RS232 cable. When using the cable, make sure to enable the “Transmission protocol” option (see section 10..5.4.2 Data output via RS232 cable”. No further settings are needed.

**Please note:** The histogram and trend diagram will be recalculated by the Msoft 7 software to be represented in high-resolution on your PC. As a consequence, the histogram and trend diagram on your PC may include more details as compared to the representation on the MiniTest 7400 gauge. Due to the lower resolution on the MiniTest gauge, some details that you can see on the PC may be not or only barely visible.

## 10. Main menu

### 10.1 General remarks

The Main Menu represents the highest level of the menu structure. From there you can quickly access all submenus for setup, data and information.



Press the function key „Main Menu“ to access the Main Menu.

Use arrow up/down keys to selected the requested submenu.

Press OK to confirm.

### 10.2 Database

Please refer to section 7.2

### 10.3 Statistics

Please refer to section 8.

### 10.4 Calibration

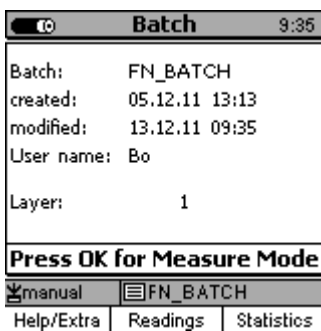
Please refer to section 5.

## 10.5 Active Batch



From the Main Menu select „Active Batch“. Press OK to confirm. The “Batch properties” will appear. Via the batch properties you can view the properties of your batch as well as the statistics. Further you can call configuration and calibration menu.

### 10.5.1 Batch properties



The batch properties of the active batch include:

- Batch name
- Date of batch creation
- Date of batch modification
- User name

### 10.5.2 Readings

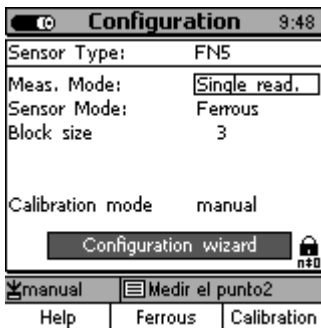
Number	Reading	Value
37	FE	94.0 µm
38	FE	92.0 µm
39	<FE	78.0 µm
40	>FE	104.2 µm
41	FE	92.4 µm
42	FE	90.6 µm
43	FE	88.6 µm
44	FE	89.6 µm
X	FE	84.4 µm
45	FE	83.0 µm
-> 46	<FE	77.0 µm

In the “Readings” menu you can view the list of readings of a batch. Press function key “Statistics” to call the statistics calculated over this batch.

Values marked by an “X” have been deleted.

See also section. 8.

### 10.5.3 Configuration



In the configuration menu you can set the parameters of a batch. You may also use the “Configuration wizard”.

Another option is to go via the calibration menu. Press function key “Calibration” followed by “Configuration”.



The configuration wizard guides you through the configuration of your batch according to your selected calibration method.

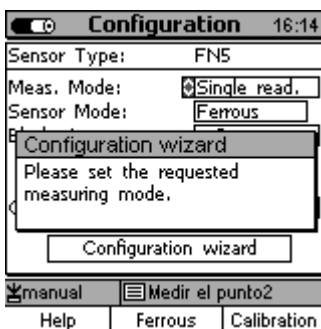
A fixed sequence of parameter queries will follow. You may either accept the preset parameter or change them according to your requirements.



Parameter: Calibration mode

You may choose between various calibration and operating modes: “Factory” (factory presetting), “Manual”, “ISO”, “SSPC”, “Rough”, “Australian”, “Swedish” and “PSPC”.

Please note: With the non-ferrous sensors “ISO”, “SSPC” and “PSPC” are not available as these calibration and operating procedures are relating to ferrous substrates.



Parameter: Measuring mode

You have the following mode options: “Single reading” and “Continuous mode”.

In the single readings mode, a reading is taken and stored to your batch automatically each time you put the sensor onto the measuring object. To take the next reading, you have to lift the sensor from the object and put it down again.

In the continuous mode, readings are taken continuously once put the sensor on the object to be measured. Once you lift the sensor, the measuring procedure will be stopped. Press OK to store the last single reading to your batch.

Parameter: Sensor mode (only available with FN sensors)



In this menu you can adjust the measuring mode according to the type of substrate.

The following options are available:

- Ferrous: magnetic induction principle. Suitable for ferromagnetic substrates such as iron, steel and alloy steel.
- Non-Ferrous: eddy currents principle for non-magnetic conducting substrates (non-ferrous metals, austenitic steel).
- Auto-F/N: The system identifies automatically the type of substrate. (only available in connection with the calibration modes factory presetting and manual calibration).



Parameter: Block size

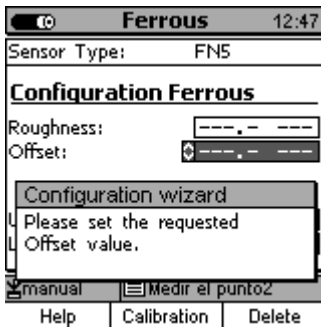
When using the block function, subsequent readings will be grouped into blocks of the same size each. The number of readings per block (block size) can be adjusted from 1 to 100. For a block, a statistic will be calculated (block statistic). Then norm-conforming operating modes “ISO”, “SSPC”, “Swedish” and “Australian” require to use the block function. Some of these norms predefine the size of block.

To calculate a single value statistic (statistic calculated over all readings of a batch) the block size must be set to “1”.



#### Parameter: Roughness

To compensate for the impact of surface roughness, a correction parameter can be set according to the surface roughness of your sample. This option is not available in the factory presetting.



#### Parameter: Offset

By using the Offset function, a constant value will be automatically added to or subtracted from the reading. This is to measure and document deviations from the set point.



#### Parameter: Upper / Lower limit

Specification limits can be used to monitor whether readings are within the range of set point. Deviations from specification limits range will be visually and acoustically indicated and marked in the statistics accordingly. The process capability indices cp and cpk will be calculated as a function of the set specification limits.



In the "Trend diagram" and "Histogram", the range within the specification limits has a grey background.

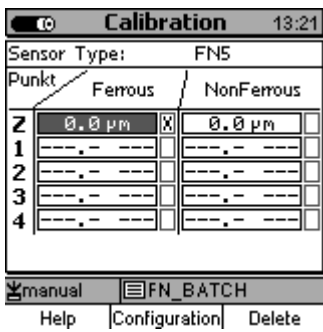
Specification limits may be entered at any time, i.e. before, during or after a series of measurements have been taken. If readings are already available, they will be re-evaluated according to the specifications limits.





Once the configuration procedure has been finished, the calibration procedure will start.

### 10.5.4 Calibration

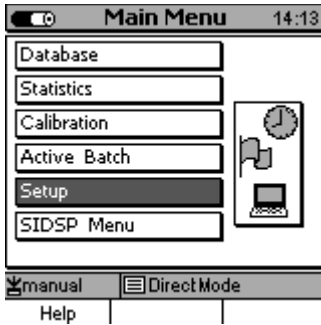


Please proceed according to section 6.

## 10.6 Settings

### 10.6.1 General remarks

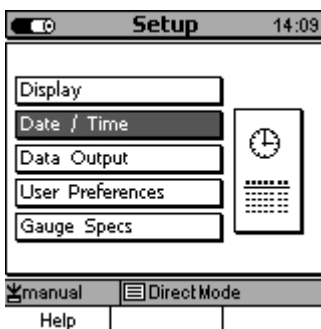
MiniTest 7400 can be adjusted according to the user preferences in many aspects.



Press function key “Main Menu”.

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

Press OK to confirm.



Use arrow up/down keys to selected the requested item from the menu and (e. g. “Date / Time”).

Press OK to confirm.

### 10.6.2 Display



Select “Display” from the “Setup” menu to enable or disable the screen and keys backlight option. Please note that the backlight is power consuming. Permanent backlight will shorten the battery / storage battery life accordingly.

Use arrow up/down keys to select “Brightness”. Press OK to confirm.

Select brightness as requested (from 20% to 100%) and press OK to confirm.

For adjusting “Contrast” proceed as above. The contrast may be adjusted from 25 to 70%

Press ESC to quit the menu. See also 4.3.1.

### 10.6.3 Date / Time



Under Date / Time you can adjust the current date and time.

See also section 4.4.1 Parameter settings.

The gauge is equipped with a quartz-controlled clock. The current time is shown at the top right of the screen.

If connected to the data printer or PC, the date and time of creation and/or the last modification date and time of a batch can be added to the print-out / evaluation protocol.

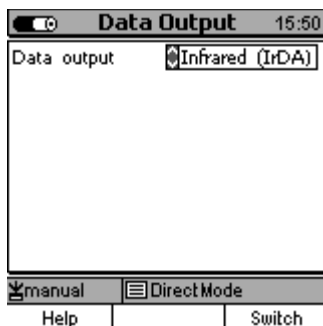
### 10.6.4 Data output

Chose „Data output“ from the “Setup“ menu. The setting options are:

- Infrared (IrDA)
- RS232 Cable

See also section 9.1 Print-out data, 9.2 Transfer data to a PC and 14.4. Accessories

#### 10.6.4.1 Data output Infrared (IrDA®)



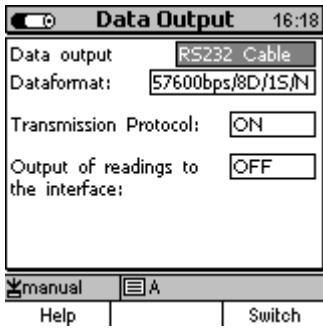
In the infrared setting, data transfer is wireless.

Chose “Infrared” if data (readings and statistics) should be printed out on the MiniPrint 7000 data printer or if they should be transferred to a PC. Make sure your PC is equipped with an IR interface.

Once the IrDA option is enabled, a permanent connection between MiniTest 7400 and a PC or printer in direct proximity. The PC will indicate a wireless connection has been established. A message will appear “MiniTest 7 in proximity”.

If further IR devices are in direct proximity, a message will appear “Further devices in proximity”.

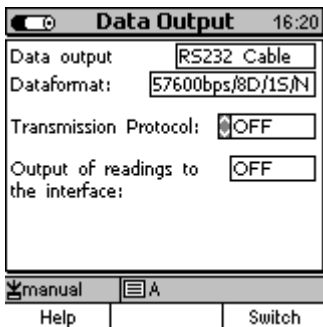
### 10.6.4.2 Data output RS232 Cable



Chose „RS232“ if your computer does not have any IR interface or if the MiniTest 7400 is permanently connected to a PC.

The baud rate can be adjusted as requested from 57600 (Standard), 38400, 19200 to 9600.

The data format “8D/1S/N“ (8 data bits, 1 Stop-Bit, No Parity) is preset and may not be changed.



The transmission protocol, the ElektroPhysik transmission protocol can be enabled or disabled.

- Set to “ON” if you are using Msoft7.
- Set to “OFF” if data transfer is made to another software. In this setting, data transfer is made in the ASCII format with carriage return and/or line feed character (CR/LF). See table below.

Description	Ref. # of reading	Space	Reading	Measuring system	Carriage Return	Line Feed
Note	Only if storage of readings into the statistics memory is enabled		aligned to the right	only if fixed point format is disabled		
Example						
Reading	0x31 0x34 0x37	0x20	0x31 0x30 0x34 0x2E 0x38	0xB5 0x6D	0x0D	0x0A
147 104.8µm						



Default setting is “Output of readings to the interface; OFF“

If you wish to output data immediately during measurement proceed as follows:

- Set “Data output” to “RS232 Cable”
- Set “Output of readings to the interface” to “ON”.

This settings is provided for transfer of readings for further processing e. g. in a quality assurance or production control software.

Direct output of readings is only possible via the “RS232 Cable“ setting. It is not available with the “Infrared IrDA” option.



The two options

- “Transfer of readings into the statistics”
- “Output of readings to the interface“ (Default setting: OFF)

can be enabled at the same time.

“Transfer or readings into the statistics” can only be enabled if “Output of readings to the interface” is set to “ON”.

To prevent memory overflow the maximum number of storable readings shouldn't be exceeded.

If MiniTest 7400 is permanently connected to a PC, documentation of readings is commonly made by a quality assurance or production control software.

If you wish to additionally store the readings in the MiniTest 7400, it is required to enable the “Transfer of readings into statistics”.

To prevent memory overflow the maximum number of storable readings shouldn't be exceeded.



The setting of “Fixed point format“ determines the data format of readings transferred via the RS232 interface.

If “Fixed point format” has been enabled, you may change the default setting “Floating point” to “Fixed point” (e.g. when connecting a data logger).

In the fixed point setting, all readings will be transferred as follows:

- metric: “µm” with one decimal place
- imperial: “mils” with two decimal places
- decimal inch: “inch” with 4 to 5 decimal places

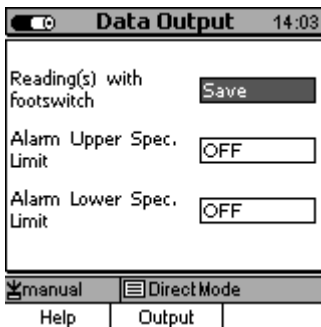
In the floating point format, readings will be transferred according to the resolution (see also section 14.2 Gauge and sensor specifications).

### 10.6.4.3 Switch function

Select „Data output“ from the Setup menu. Press OK to confirm.

Now press the function key “Switch” and the window as below will open.

Press “Data output” to go back to the data output (interface) menu.



In the continuous mode you the following options to save readings:

- by pressing OK
- by actuating the footswitch.

In the continuous mode the “Reading(s) with footswitch” must be set to “Save”. So a reading will be stored once you actuate the footswitch.

In the single readings mode it should be set to “delete”. So actuating the footswitch, will delete the last reading.

An alarm output is available to indicate deviations from the specification limits. To distinguish between upper and lower limit, you can assign different signal tones. The tones can vary in length. The following setting options are available:

(OFF, 50ms, 100ms, 150ms, 200ms, 250ms, 300ms, 350ms, 400ms).

## 10.6.5 User preferences



Select „User preferences“ from the Setup menu to adjust the following parameter:

- Language: English, German, French, Spanish, Portuguese,
- 
- Measuring system: metric (auto):           (µm, mm, cm)
- cm (fixed)
- mm (fixed)
- µm (fixed)
- Decimal inch
- imperial:                     (mils, inch)

S

In the metric (auto) option, the gauge selects automatically µm, mm or cm according to the thickness being measured. The reading will be represented in floating point format.

In the cm (fixed), mm (fixed), µm (fixed) or Decimal inch option, the reading will be represented in fixed point format.

Loudspeaker: ON / OFF. If enabled, any acquisition of reading or key action will be confirmed by an audible signal. The earphone output will remain active.

Signal volume: low, medium, high.

Auto switch off: 1,3,10, 30 minutes or disable

To save power you can adjust the automatic switch off. So the gauge will switch off automatically after being idle for the set period of time.

Please note: In connection with the data transfer software Msoft7, the MiniTest will be permanently switched on. So the automatic switch off is disabled.

Entry accepted: 0, 5, 1, 1,5 or 2 s

The “entry accepted time” determines the period of time to elapse after a numerical or alphanumeric entry before your entry is saved automatically.

Modification lock: ON/OFF

To prevent accidental changes, you can enable the modification lock. However, this will not lock the measure mode, so you can continue to take readings. The modification lock is password protected. Please note: the entry is case-sensitive. In the event of password being lost, a Total Reset made. Please note: A Total Reset will delete all readings and settings. See also section 4.4.1 Parameter settings.

### 10.6.6 Gauge specifications

Gauge Specific. 15:37	
Type	MiniTest 7400FH
Serial No.	102567
Hardware Version	1.5
Software Release	2.12
Comm.Process.Vers.	1.02c
manual FN_BATCH	
Help	Sensor

Select "Gauge specs" from the Setup menu to view the specifications of the gauge.

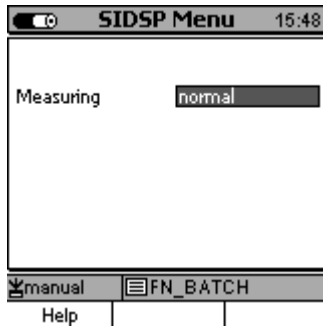
To view the sensor specifications, press function key "Sensor".

Sensor Specific. 15:42	
Type	FN5
Serial No.	109442
Hardware Version	1.5
Software Release	1.12
Data Set Version	1.15
manual FN_BATCH	
Help	Gauge

Please advise both gauge and sensor specifications for any after-sales-service requests.



## 10.7 SIDSP® menu



In this menu you can adjust the SIDSP® properties for data processing within the sensor. Currently only the “Measuring” mode can be adjusted. Given the continuous SIDSP® technology development, further parameter settings will become available in the future.

Measuring: normal, fast, high precision

The setting determines the sensor properties for acquisition of single readings. According to your setting you can optimise the measuring rate or precision.

Press OK and use arrow u/down keys to make your selection (normal, fast, high precision).

### **normal:**

default setting for the standard measuring mode. In this setting, measuring rate and precision are set to a medium value.

### **fast:**

In this setting, the measuring rate will be increased. It is recommended for quick measurement on large surfaces.

### **precise:**

This setting enables maximum precision; the measuring rate is secondary.

To take profit of the increased measuring precision, it is important to take readings always at identical spots. If you do not hit always the same spot, the gauge will show the variations as they really exist due to the thickness variations over the sample surface. To achieve maximum reproducibility, it is recommended to use the precision measuring stand in order to fix the sample properly.

For taking readings without any assistance in fixing the measuring object or sensor it is sufficient to adjust the “normal” setting, whereas the “precise” setting will achieve optimum results when using the measuring stand.

---

## 11. Special functions

### 11.1 Initialization

To perform at first start-up or as requested.

Press ON/OFF button together with ESC.

First release ON/FF. The initialising sequence will start.

- A language flag appears. s erscheint eine Flagge mit der Landessprache.  
Use arrow up/down keys to make your selection.  
Press OK to confirm or ESC to abort.
- The Total Reset window appears.  
Press "NO" to abort or "Yes" if you wish to make a Total Reset



#### Caution !!

- A Total Reset will irrevocably delete all data in memory. All settings except the language setting will be reset to the factory settings.
- The Total Reset action will also delete all directories and batches, including all readings, statistics and calibration values.
- To abort the Total Reset you have to choose "NO" for the "Restore factory settings?" query. Only the changed language setting will be stored.
- „The power supply“ option may be adjusted to "Battery" or "Accumulator". It must be set according to the power source you are using otherwise the battery state will not be indicated correctly due to the different voltage requirements.

## 11.2 Special functions menu

If the gauge is switched on and you press the ON/OFF button for more than one second, the “Special functions” menu will appear. This menu may be called up at any time and is available across the system. The “Print-screen” option allows you to make screenshots (hardcopy) to a printer or PC. Other quick access options are provided for backlight (ON/OFF) and measuring system (metric / imperial).

The quick access to the measuring system may be of interest for users of countries where both measuring systems are used. Once the measuring system changed, the readings will be indicated according to your setting.

Use arrow up/down keys to make your selection.

Press OK to confirm your selection.

Press ESC if you wish to abort. The gauge will go back to the previous setting.

The “Special functions” menu includes the following functions:



- Print Screen (print-out of screenshot on MiniPrint 7000 data printer or transfer to PC)
- Backlight (of display and keyboard) ON/OFF
- Backlight (of display and keyboard) ON/OFF
- Metric system ( $\mu\text{m}/\text{mm}$ ) Imperial system (mils/inch)

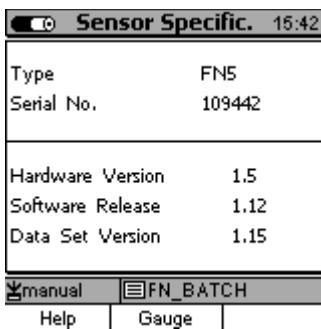
All these setting options except the Print Screen item may also be accessed via the standard menu system.

The **Special functions** menu allows you quick access to the above functions at any time during operation, also while you are taking readings, for instance. After you have made the settings as requested, you may continue your current action. As a consequence, valuable time will be saved.

### 11.3 Recalibrate the factory zero point

For a factory calibration, the zero point is commonly taken on a plain and even measuring standard (zero plate). Compared to the surface of such standard, the surface of your uncoated sample might represent variations with respect to the shape i.e. your sample might exhibit a certain curvature. In order to compensate for such variations, it is vital to perform a zero calibration on your uncoated sample. A zero calibration will adapt the characteristic curve of the sensor as a function of your uncoated sample. In most cases, such recalibration of the zero point will be sufficient to ensure the specified accuracy. Prerequisite is that there are no deviations from the zero point when taking the zero point on the zero plate (supplied with the gauge). Please refer also to section 6.2.1.

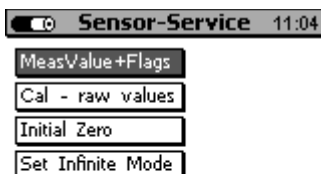
If, however, there are deviations from the zero point higher than specified in the sensor data sheet, it is recommended to recalibrate for the factory zero point. The deviation from the zero point is specified as a nominal value. For the FN5 sensor, for instance, the deviation from zero point is specified as 1.5  $\mu\text{m}$ .



Sensor Specific. 15:42	
Type	FN5
Serial No.	109442
Hardware Version	1.5
Software Release	1.12
Data Set Version	1.15
manual FN_BATCH	
Help	Gauge

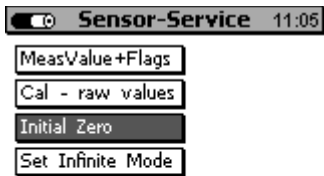
To recalibrate the factory zero point proceed as follows:

- Setup
- Gauge Specs
- Function key "Sensor"
- Press arrow up
- Press Function key on the right (no inscription)
- Press OK to confirm.



Sensor-Service 11:04	
MeasValue+Flags	
Cal - raw values	
Initial Zero	
Set Infinite Mode	

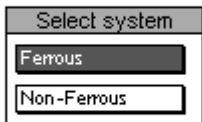
The Sensor-Service menu appears.



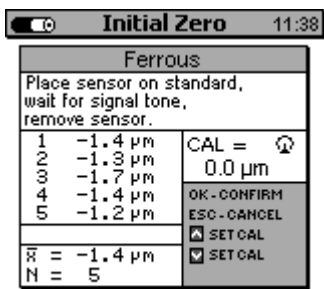
Scroll down to "Initial Zero".



If an FN sensor is connected (e. g. FN 1.5/0.7), the Select system menu appears.



Use arrow up/down keys to select the measure mode for which the recalibration of zero point should be done.



To recalibrate the zero point please proceed very carefully. Make sure to use a blank and even substrate.

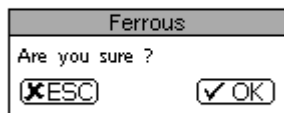
Clean both, sensor tip and zero plate before measuring. Any dirty particle will impair accuracy. Please refer also to section 6.1.

Perform the zero recalibration according to 6.4.3.2.

Press OK to complete the procedure. A security query will follow.



If the factory presetting should be replaced by your recalibration, press OK to confirm.

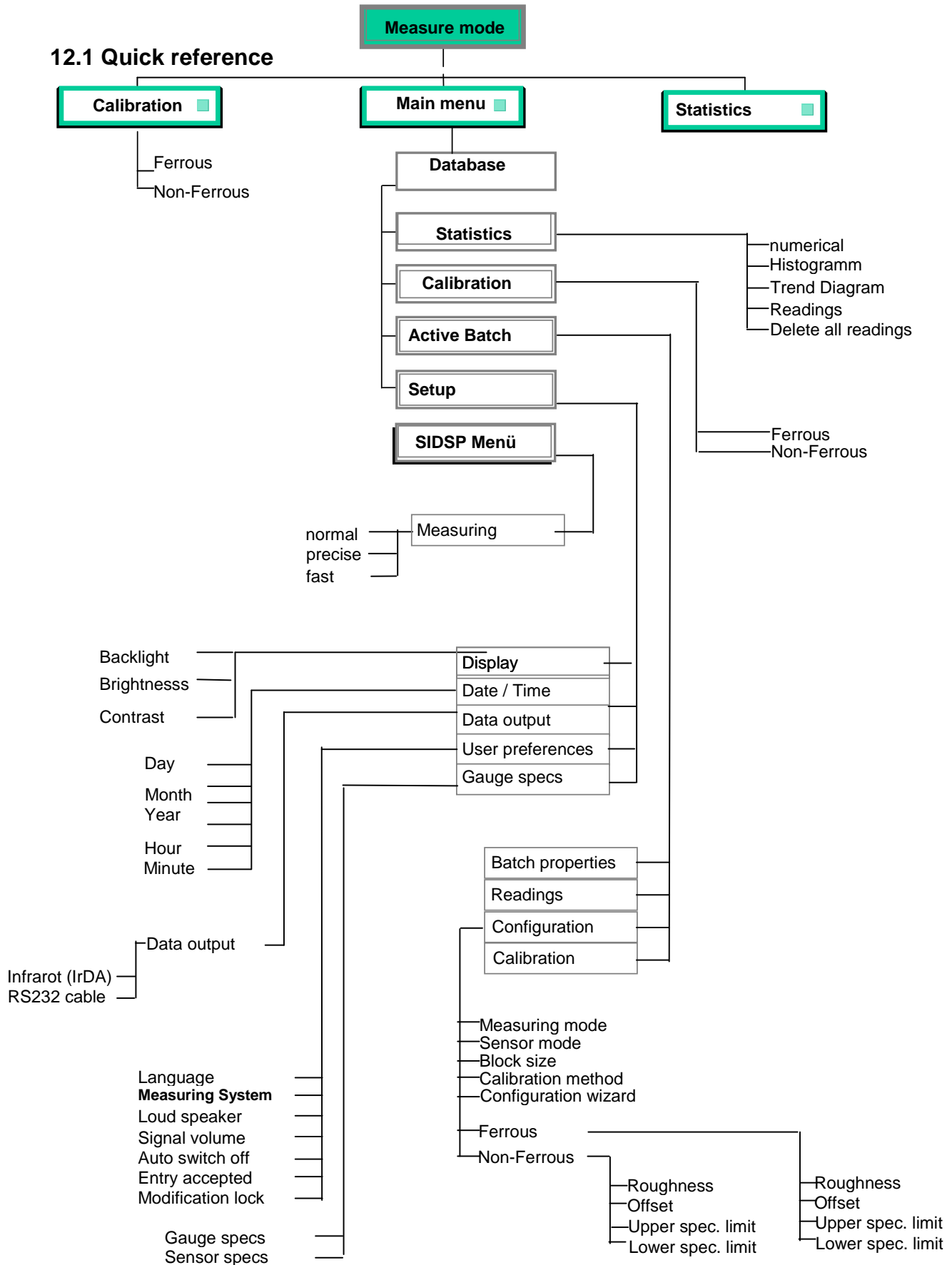


To abort, press ESC. The factory presetting will persist.

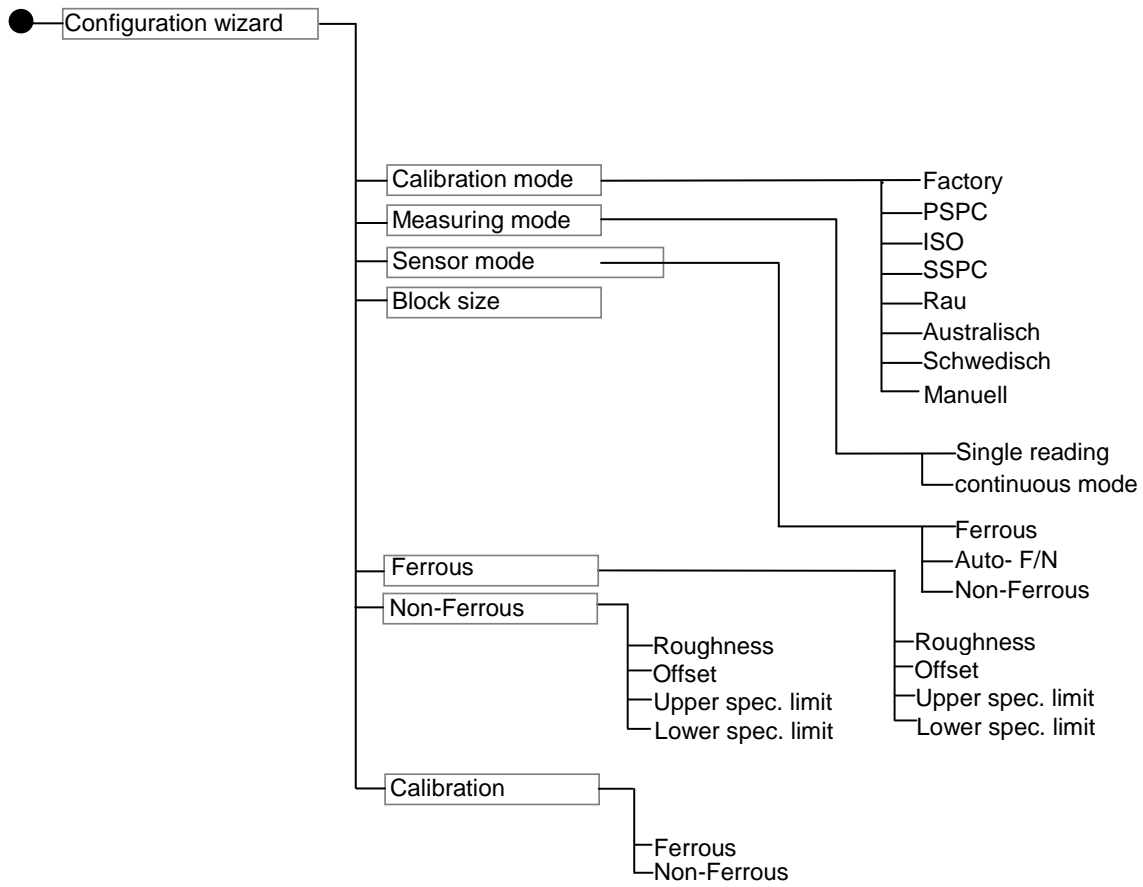
Help

# 12. Synopsis of functions

## 12.1 Quick reference



## 12.2 How to configure a batch



---

## 13. Care and maintenance

### 13.1 Care

Use a soft damp cloth with water or a mild detergent to clean the gauge, sensor 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.

#### 13.1.1 Using NiMH storage batteries

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

- New storage batteries reach their maximum capacity after a few charge and discharge cycles. The full capacity of older storage batteries can be restored through frequent charge and discharge cycles. For such purpose, special charger units should be used.
- Remove the NiMH storage batteries if the MiniTest7400 gauge is not in use for a longer period of time.
- For extended stocking periods make sure the NiMH storage batteries are fully loaded. Reload regularly at 12 months' intervals.
- Recommended storage temperature: + 10 °C and + 30°C at a relative air humidity of around 50%.
- To extend the battery service life it is recommended to use the gauge in power saving mode. If possible, enable the automatic switch off function to save battery.



---

## 13.2 Maintenance

Generally, no maintenance work is required for MiniTest 7 series.

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

## 14. Technical data

### 14.1 Gauge specifications

Properties	MiniTest 7400
Max. number of batches	500
Number of storable readings	250.000
Statistical functions (per batch)	Number of readings, min, max, average, standard deviation, variation coefficient, block statistics (norm-conforming, user adjustable), process capability indices cp and cpk, histogram, trend diagram
Calibration procedures according to int'l norms and standards	"ISO" - ISO 19840:2004(E), "SSPC" - SSPC-PA2(May 1, 2004), "Schwedisch" - SS 184160 (1992-03-11), "Australisch" - AS 3894.3-2002
Calibration	up to 5 points, user-adjustable offset
Monitoring of limits	Audible and visual alarm in when exceeding limits
Measuring systems	µm, mm, cm; mils, inch, thou
Operating temperature range	-10° ... +60°C
Stocking temperature range	-20° ... +70°C
Datat ports	IrDA <sup>®</sup> 1.0 (Infrared) USB and RS232 via adaptor unit (available as an option)
Power supply	4 x AA (LR06) batteries, or via mains unit (90 – 240V ~ / 48-62 Hz)
Application norms	DIN EN ISO 1461, 2064, 2178, 2360, 2808, 3882, 19840 ASTM B 244, B 499, D 7091, E376 AS 3894.3; SS 1841 60, SSPC-PA 2,IMO-PSPC
Display	Graphics display 160 x 160 Dots, backlit
Dimensions	153 mm x 89 mm x 32 mm
Weight	310 g (Gauge incl. batteries)

## 14.2 Sensor specifications

Standard sensor	HD sensor	Measuring range	Accuracy*1.5 (of reading)	Repeatability (standard deviation of reading) *5	Low range resolution	Minimum curvature radius convex*2, *6	Minimum curvature radius concave*2, *6	Minimum measuring area*2,*6 without measuring stand	Minimum measuring area*2,*3,*6 with measuring stand	Minimum substrate thickness*2,*6	Measuring rate in continuous mode	Max. measuring rate in single readings mode
F 0.5	F 0.5 HD	0...0.5 mm, 20 mils	+/- (1 µm + 0.75 %)	+/- (0.5 µm + 0.5%)	0.02 µm	1.0 mm	7.5 mm	Ø 14 mm	Ø 5 mm	0.3 mm	20 readings per second	70 readings per minute*4
F 1.5	F 1.5 HD	0...1.5 mm, 60 mils	+/- (1 µm + 0.75 %)	+/- (0.5 µm + 0.5%)	0.05 µm	1.0 mm	7.5 mm	Ø 14 mm	Ø 5 mm	0.3 mm		
F 1.5-90		0...1.5 mm, 60 mils	+/- (1 µm + 0.75 %)	+/- (0.5 µm + 0.5%)	0.05 µm	--	5 mm	Ø 10 mm	Ø 5 mm	0.3 mm		
	F 2 HD	0.2 mm, 80 mils	+/- (1.5 µm + 0.75 %)	+/- (0.8 µm + 0.5%)	0.1 µm	1.5 mm	10 mm	Ø 14 mm	--	0.5 mm		
F 5	F 5 HD	0.5 mm, 200 mils	+/- (1.5 µm + 0.75 %)	+/- (0.8 µm + 0.5%)	0.1 µm	1.5 mm	10 mm	Ø 14 mm	Ø 10 mm	0.5 mm		
F 15		0...15 mm, 590 mils	+/- (5 µm + 0.75 %)	+/- (2.5 µm + 0.5%)	1 µm	5 mm	25 mm	Ø 25 mm	Ø 25 mm	1.0 mm		
F 35		0...35 mm, 1380 mils	+/- (20 µm + 0.75 %)	+/- (10 µm + 0.5%)	5 µm	50 mm	50 mm	Ø 100 mm	--	1.5 mm		
N 0.2	N 0.2 HD	0.0.2 mm, 8 mils	+/- (1 µm + 0.75 %)	+/- (0.5 µm + 0.5%)	0.02 µm	1.0 mm	7.5 mm	Ø 14 mm	Ø 5 mm	40 µm		
N 0.7	N 0.7 HD	0.0.7 mm, 27 mils	+/- (1 µm + 0.75 %)	+/- (0.5 µm + 0.5%)	0.05 µm	1.0 mm	7.5 mm	Ø 14 mm	Ø 5 mm	40 µm		
N 0.7-90		0.0.7 mm, 27 mils	+/- (1 µm + 0.75 %)	+/- (0.5 µm + 0.5%)	0.05 µm	--	5 mm	Ø 10 mm	Ø 5 mm	40 µm		
N 2.5	N 2.5 HD	0...2.5 mm, 100 mils	+/- (1.5 µm + 0.75 %)	+/- (0.8 µm + 0.5%)	0.1 µm	1.5 mm	10 mm	Ø 14 mm	Ø 10 mm	40 µm		
N 7		0.7 mm, 280 mils	+/- (5 µm + 0.75 %)	+/- (2.5 µm + 0.5%)	1 µm	15 mm	25 mm	Ø 23 mm	Ø 20 mm	40 µm		
FN 1.5	FN 1.5 HD	F: 0...1.5 mm, 60 mils N: 0.0.7 mm, 27 mils	+/- (1 µm + 0.75 %)	+/- (0.5 µm + 0.5%)	0.05 µm	1.0 mm	7.5 mm	Ø 14 mm	Ø 5 mm	F:0.3 mm N: 40 µm		
FN 1.5-90		F: 0...1.5 mm, 60 mils N: 0.0.7 mm, 27 mils	+/- (1 µm + 0.75 %)	+/- (0.5 µm + 0.5%)	0.05 µm	--	5 mm	Ø 10 mm	Ø 5 mm	F:0.3 mm N: 40 µm		
FN 5	FN 5 HD	F: 0...5 mm, 200 mils N: 0...2.5 mm, 100 mils	+/- (1.5 µm + 0.75 %)	+/- (0.8 µm + 0.5%)	0.1 µm	1.5 mm	10 mm	Ø 14 mm	Ø 10 mm	F:0.5 mm N: 40 µm		

Footnotes see next page

- 
- <sup>1</sup> With multi-point calibration, relating to the supplied standards under laboratory conditions
  - <sup>2</sup> With zero calibration and if calibration was made close to the coating thickness to be expected
  - <sup>3</sup> If the precision stand is used, not applicable for HD-sensors
  - <sup>4</sup> If the „quick“ filter has been selected, the measuring rate is mainly dependent on handling
  - <sup>5</sup> According to DIN 55350 part 13
  - <sup>6</sup> With multi-point calibration, values better than the specified data can be obtained
  - <sup>7</sup> including coating

## 14.3 Supply schedule

### 14.3.1 MiniTest 7400 Coating thickness gauge

Description	Item #
<b>MiniTest 7400, Display unit without sensor</b>	80-170-0000
including	
<ul style="list-style-type: none"> <li>- ■ MSoft 7 Professional software on USB memory stick</li> <li>- ■ Instructions manual in German, English, French and Spanish</li> <li>- ■ Short instructions</li> <li>- ■ 4 AA cells, type LR06</li> <li>- ■ Plastic carrying case</li> </ul>	

### 14.3.2 Interchangeable SIDSP<sup>®</sup> sensors for MiniTest 7400

Description	Typ	Item #
<b>SIDSP<sup>®</sup> sensor for nonmagnetic coatings applied on iron and steel, also on alloyed or tempered steel (magnetic induction principle)</b>		
	F0.5	80-173-2000
	F1.5	80-173-0000
	F2	80-173-0300
	F5	80-173-0400
	F15	80-173-0700
	F35	80-173-1700
Rugged sensor version (HD) for use in harsh environments	F0.5 HD	80-173-3700
featuring special dust- and dirt-protection and	F1.5 HD	80-173-3000
sealed against paint	F2 HD	80-173-3300
	F5 HD	80-173-3400

Sensor with 90° cable outlet for measuring objects difficult to access or for measurements in tubes and pipes.	F1.5 R	80-173-2400
<b>SIDSP® sensor for any electrically insulating coatings applied on nonferrous substrates, also on austenitic steel (eddy currents principle)</b>		
	N0.2	80-173-2100
	N0.7	80-173-0100
	N2.5	80-173-0500
	N7	80-173-1600
Rugged sensor version (HD) for use in harsh environments	N0.2 HD	80-173-3800
featuring special dust- and dirt-protection and	N0.7 HD	80-173-3100
sealed against paint	N2.5 HD	80-173-3500
Sensor with 90° cable outlet for measuring objects difficult to access or for measurements in tubes and pipes.	N0.7 R	80-173-2500

<b>Description</b>	<b>Typ</b>	<b>Item #</b>
<b>Dual sensor combining the magnetic induction and eddy currents principles</b>		
	FN1.5/0.7	80-173-0200
	FN1.5/0.7 R	80-173-2600
	FN5/2.5	80-173-0600
Rugged sensor version (HD) for use in harsh environments	FN1.5/0.7 HD	80-173-3200
featuring special dust- and dirt-protection and	FN5/2.5 HD	80-173-3600
sealed against paint		
Sensor with 90° cable outlet for measuring objects difficult to access or for measurements in tubes and pipes.	FN1.5/0.7 R	80-173-2600

---

each sensor is delivered with

- 1 or 2 reference zero plates (depending on sensor model)
- 3 precision standards

### 14.3.3 Accessories for SIDSP® sensors

Description		Item #
Sensor cable for MiniTest 7400	90° cable outlet, 1m standard length	81-170-0001
Sensor cable for MiniTest 7X00	90°, 5m cable length	81-170-0005

## 14.4 Accessories

Description	Item #
MiniPrint 7000 data printer, including charger unit 100V..240V / 9V 1,12A	80-202-0001
Thermo paper roll, 58 x Ø 31mm for MiniPrint 7000	06-007-0007
NiMH storage battery, Mignon AA HR6 1,2V / 2000 mAh	02-064-0001
Quick charger for NiMH storage batteries	02-070-0042
Mignon battery 1,5V AA\LR6\alkaline	02-064-0008
Mains unit 9V/1,12A for MiniTest 7400	80-900-0005
Rubber protection case with positioning device and shoulder strap	82-010-0064
Shoulder bag for MiniTest 7X00	82-010-0007
Dust protection pouch for MiniTest 7X00	85-199-0001
IrDA® / USB converter for wireless data transfer to a desktop computer Direct support of Win9x, WinME, Win2000, WinXP, WinVista, Win7 through universal driver (easy to install); cable 100cm with USB connector	85-139-0014
RS 232C adapter cable for MiniTest 7400	85-159-0006
USB adapter cable for MiniTest 7400	80-900-0006
Multi-purpose connection box, 3 connection and USB port, USB cable for connecting: mains unit, foot switch, alarm device, headphones	80-904-0400
Precision support for F05, N02, FN1.5/0.7, F1.5 und N0.7 sensor, incl. clamping sleeve	80-900-0200
Manufacturer's Test Certificate according to DIN 55350 M for MiniTest 7400 including one sensor	
Manufacturer's Test Certificate according to DIN 55350 M for calibration foils	



## 15. Annexe

### 15.1 Error messages and troubleshooting

Error message	Cause of error	Remedy
"Please check clock settings"	If you insert batteries at initial use or if the gauge has been cut from power supply for more than 5 minutes	Reset clock (s. section 10.5.3)
"Low Bat !!!"	Though you can continue to measure, it is recommended to change batteries. If battery voltage is below minimum, the gauge will switch off automatically.	Change batteries. Dispose batteries according to your local regulations.
<p>"Please hold probe in air(infinite range) !! "</p> <p>(Briefly appears on display at switch on)</p> <p>The message does not disappear, and the following message appears after about 10 sec:</p> <p>"Confirm sensor in infinite range"</p>	<p>At switch on, the sensor was held in proximity to metal parts.</p> <p>a) The sensor is influenced by any ferritic object or magnetic fields or is placed on a base such as the measuring stand.</p> <p>b) Please perform an infinite adjustment (see also section 6.1).</p>	<p>Make sure to keep sufficient distance to any metal parts. See also section 6.1. The distance must be approximately 5 times the measuring range.</p> <p>Now the message on display should disappear and the gauge should switch to measure mode.</p> <p>Please keep the sensor away from metallic objects or magnetic fields (at least 5 times the measuring range).</p> <p>If this message persists, press Function key "Infinite".</p> <p>Now the message should disappear and the gauge is ready for measurement.</p> <p>Note: Make sure to press the Infinite function key only if the</p>

Error message	Cause of error	Remedy
		error source has been removed!
<p>“Refresh infinite value !!!”</p> <p>(The infinite value should be actualised)</p>	<p>The sensor has been held beyond the infinite range for a longer period of time. To ensure the guaranteed measuring accuracy, the infinite value must be refreshed.</p> <p>See also section 6.1</p>	<p>Lift the sensor and hold in the air.</p> <p>If the message persists, please press Refresh function key.</p> <p>If a measurement is in progress, press ESC to suppress the query for refreshing the infinite value.</p> <p>However, this should be done only as an exception as otherwise the accuracy cannot be guaranteed any.</p>
<p>“Sensor type not compatible with batch ! “</p> <p>“Service failure”</p>	<p>The currently active batch has been configured for a sensor other than the one you are currently using. The sensor does not match the batch.</p>	<p>Select or create another batch to match the sensor you are using.</p>
<p>“Batch readings do not match connected sensor !”</p> <p>“Delete readings?”</p>	<p>The currently active batch has been configured for a sensor other than the one you are currently using. The sensor does not match the batch.</p>	<p>You have the following options:</p> <ul style="list-style-type: none"> <li>- select another batch that matches your sensor</li> <li>- create a new batch matching to your sensor</li> <li>- delete readings in the active batch and take new ones</li> </ul> <p>To abort deletion of readings press ESC.</p> <p>To confirm deletion press OK.</p>
<p>“Full memory capacity !”</p>	<p>Probable cause:</p> <p>You have reached maximum number of storable readings.</p> <p>You have reached maximum</p>	<p>Delete readings, batches or directories in the database you do not need any more.</p>

<b>Error message</b>	<b>Cause of error</b>	<b>Remedy</b>
	number of entries in the data base.	
"Memory optimization in progress"	Message appears briefly on display.	Automatic procedure. No further action required.
"Check sensor connection !"	Possible cause: <ul style="list-style-type: none"> <li>- the sensor has been removed while the gauge was switched on</li> <li>- loose probe connection</li> <li>- cable damaged</li> <li>- sensor defective</li> </ul>	Please check the options. If the sensor is defective, please change it or contact after sales service.
"No sensor connected ! "  "Changes not possible !"	Sensor connecting failure.  Possible causes: <ul style="list-style-type: none"> <li>- no sensor connected</li> <li>- loose probe connection</li> <li>- cable damaged</li> <li>- sensor defective</li> </ul>	Please check the options. If the sensor is defective, please change it or contact after sales service.
"Sensor failure ""		Please contact after-sales service.

The following errors may be remedied by a total reset (see section 10.1)

- keyboard failure
- no further measurements possible
- illogical readings

If the gauge cannot be switched off via the ON/OFF button, remove and reinsert batteries

---

## 15.2 Statistical Terms

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

### Average (Mean)

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

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

### Standard Deviation (STD. DEV.) s (s = $\sigma$ = 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  $s^2$ .

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

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

### 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).

### Variation coefficient (Var.-coeff.)

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

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

---

## Process capability index (Cp)

The *cp* index is a measure of the spread of the readings as related to the specification limits. Only the spread is of importance here. The *cp* index is calculated as follows:

$$C_p = \frac{USL - LSL}{6\sigma}$$

where USL = Upper specification limit

where LSL = Lower specification limit

## Process capability index (Cpk)

In addition to the spread, the **cpk** index also takes into account the location of midpoint as related to the specification limits.

$$C_{pkL} = \frac{\bar{x} - LSL}{3\sigma}$$

$$C_{pkU} = \frac{USL - \bar{x}}{3\sigma}$$

$C_{pk} = \text{Min} \{ C_{pkL}, C_{pkU} \}$

where USL = Upper specification limit

where LSL = Lower specification limit.

---

## 15. 3Safety notes

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

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

### **Storage 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 respective instructions manual for detailed information on safety issues. Do only connect original accessories recommended by the manufacturer of the MiniTest 7400.

### **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.

---

## 15.4 Declaration of Conformity

ElektroPhysik, Pasteurstr. 15, D-50735 Cologne, Germany, manufacturer of MiniTest 7400, declare in sole responsibility that the products this declaration relates to is in conformity with the provisions of directive 89 / 336 / EEC (Electromagnetic compatibility), in Germany: EMVG (Gesetz über die elektromagnetische Verträglichkeit) of November, 9<sup>th</sup>, 1992.

---

## 15.5 After Sales Service

The MiniTest 7400 gauges are manufactured according to state-of-the-art production methods using high-quality components. Careful production controls along with a Certified Quality Management according to DIN EN ISO 9001 ensure optimum product quality.

Should you nevertheless notice any errors, please contact ElektroPhysik and advise your problem.

Please retain the original packing for future transportation needs if a repair should become necessary.

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

ElektroPhysik

Dr. Steingroever GmbH & Co. KG

Pasteurstr. 15

50735 Koeln, Germany

Tel.: +49 221 75204-0

Fax: +49 221 75204-69

E-Mail: [info@elektrophysik.com](mailto:info@elektrophysik.com)

Please refer to our website for the local representative of ElektroPhysik in your country:

<http://www.elektrophysik.com/company/agencies-abroad.html>



---

## Index

### A

alphanumerical entry ..... 79  
Australian ..... 35  
automatic switch off ..... 79  
average ..... 100

### B

backlight ..... 74, 83  
batteries  
  inserting ..... 9, 14, 88, 97  
battery symbol ..... 14

### C

calibration mode ..... 10, 11, 33, 40, 48  
charger unit  
  external ..... 14  
command and navigation block ..... 10  
**Configuration** ..... 23  
Contrast ..... 74  
**Correction value** ..... 34, 36

### D

data format ..... 65, 76, 78  
Data output ..... 64, 67, 75, 76, 77, 78  
Direct mode ..... 10, 18, 24, 53  
display ..... 10, 83, 97

### E

entry accepted time ..... 79  
external charger ..... 14

### F

Floating point ..... 78  
foot switch ..... 13  
Function key ..... 10, 13, 21, 22, 84, 97

### G

Gauge specifications ..... 21, 80, 90

### I

Infrared ..... 64, 65, 66, 67, 75, 77, 90  
ISO ..... 33, 34, 36

### L

language ..... 10  
LSL ..... 101

### M

Main Menu ..... 21  
Mean value ..... 47  
Measuring system ..... 76, 79  
Measuring System ..... 12

Modification lock ..... 79  
multi-purpose socket ..... 13

### N

norms and standards ..... 7, 8, 90

### O

Online statistics ..... 19

### P

Print Screen ..... 83  
Printing Sequence ..... 64, 66

### R

Rough ..... 36

### S

sensor specifications ..... 78, 80  
shot-blasted surfaces ..... 28  
single readings ..... 28, 38, 46, 47, 57, 58, 61,  
  63, 70, 78, 81, 91, 100  
specification limits ..... 57, 58, 59, 61, 72, 78,  
  101  
SSPC ..... 7, 8, 24, 28, 29, 36, 51, 70, 71, 90  
SSPC-PA2 ..... 36  
storage battery ..... 74, 96  
Swedish ..... 34  
switch off ..... 14, 88, 97  
**Switch ON** ..... 10

### T

Total Reset ..... 10, 82  
Transmission Protocoll ..... 65  
two-point calibration ..... 27, 35, 38

### U

USL ..... 101

### V

variance ..... 100  
visual alarm ..... 57, 90

### Z

Zero Point calibration ..... 40