RI-1000
Rail Inspect 1000

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USER GUIDE

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1. General description

The measuring device type RI-1000 was developed to check irregularities both on the running and guiding surfaces of the rail. Working on capacitive principle, the device is to check rail straightness that allows quick deformation measurement on geometric structures. Device has no moving parts. Applying above working principle, measurement of surfaces with electrically conductive patterns irrespectively of their material composition is also possible.

The hand-held computer unit (mobile phone or tablet PC) using communication among Bluetooth devices over a radio frequency cares for device control and data storage. Measurement software runs on Android operation system (OS).

Measurement process is influenced by the resistance of medium lying between the surface to be measured and the device sensors. It is highly recommended to keep device's measurement screen clean and also wipe the surface to be measured clean prior to the measurement. (You need a clean and dry surface.)

Only contact points on device's both ends touch the rail surface thus ensuring its proper positioning on the rail. Contact points should have an electrically conductive contact to the rail surface to be measured. Electrically non-conductive material compositions as well as rusty surface make application instable; no data of such measurements will be stored.
Device also fits to measurements on insulated joints.

2. Decription of device and its accessories

Applying distance measurement in 200 different points, the device calculates values of surface deviation from a straight line on one meter basis. As the difference between the two contact points is above one meter, please, mind the marks on device side panel indicating the one meter measurement basis to set the proper position.

There is also an arrow in the middle of the side panel to place it exactly over the weld, thus allowing measurement of two 0.5 m long pieces of rail on both sides of the weld.

Fig. Nr.2.1.   Marks for proper positioning

Hand-held computer unit (mobile phone or tablet PC) applied to process, store and visualize measurement data uses communication among Bluetooth devices over a radio frequency. The measurement software runs on Android OS. The measurement software is a user-

friendly application; its operation is simple, easy to learn and to understand.

Battery
Device runs on two AA batteries or rechargeable batteries. Turn and remove battery cover on the edge of the device to replace batteries.

Fig. Nr. 2.2 Replacement of batteries

Switch on the device
The only handling knob on the instrument front panel is the ON/OFF switch. Light indicates the switched on status, device is ready for establishing RF communication.

Fig. Nr. 2.3 Front panel

Communication via radio frequency (RF)
Hand-held computer unit (mobile phone or tablet PC) applied to process, store and visualize measurement data uses communication among Bluetooth devices over a radio frequency. The RF communication unit is behind the front panel with the ON/OFF switch.

Device is only touches the rail with its two ends. Contact points should have an electrically conductive contact to the rail. Adjust contact points to fit to measurement of either the running or the guiding surface of the rail.

Measurement on the running surface is preset to UIC 60 rail type, while measurement on the guiding rail surface is completed 14 mm beneath the level of rail head top.

Fig. Nr. 2.4. Contact points

3. Measurement programme

The software runs on Android OS. The measurement software is a user-friendly application; its operation is simple, easy to learn and to understand. Save a link to the programme on the desktop for easy access.

3.1. Introducing the measurement screen

The measurement screen of the programme is shown on Figure Nr. 3.1.
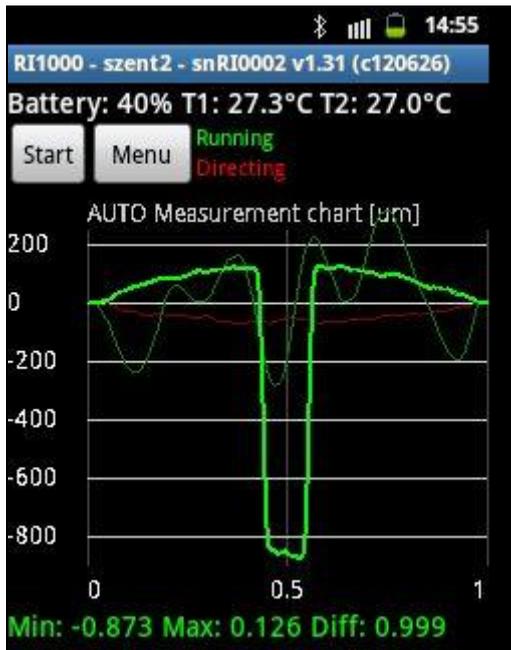

Fig. Nr. 3.1. Measuring programme

Information about measurement is automatically updated. After the logo "RI1000", the project name, device number and firmware version as well as the programme version running on the handheld computer appear in the upper banner of the display.

Battery status, outside and inside temperature of the device are displayed next. Measurement results are visualized in both graphic and numeric formats. Maximum and minimum deviation values calculated to the straight line as well as their difference becomes regularly refreshed on the display after each measurement completed. Measurement unit of numeric data is expressed in μm.

The graph of the active measurement is blinking while in graphic mode (line width of the graph is changing), its colour changes according to the surface checked. Colour changes to dark that indicates loaded measurement or measurement of a different surface. Green stands for the measurement on the running surface, red is for that on the guiding surface. The one meter long measurement basis serves as horizontal axis, check the signs "0", "0.5" and "1" on the side panel of the device.

Vertical axis changes according to the value assessed between the minimum of +200... -200 μm and the maximum of +1000... -3000-μm.

3.2. Starting the measurement

After starting the measurement, the information screen displayed on Fig. Nr. 3.2 will appear.

After the logo "RI1000", the project name, device number and firmware version as well as the programme version running on the handheld computer appear in the upper banner of the display. In case no active project is selected and device has no connection yet, the message "Untitled" appears instead of the project name, while "sn?v?" replaces the serial number and firmware version.

Next to the upper banner, battery status (BATTERY 0-100%), the housing's outside (T1 °C) and inside temperature values (T2 °C) are shown.
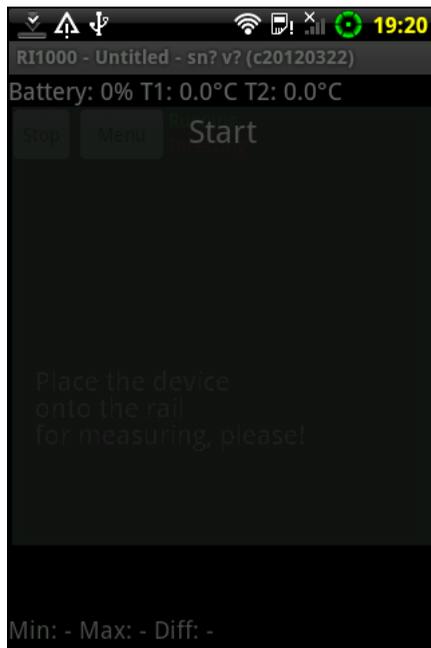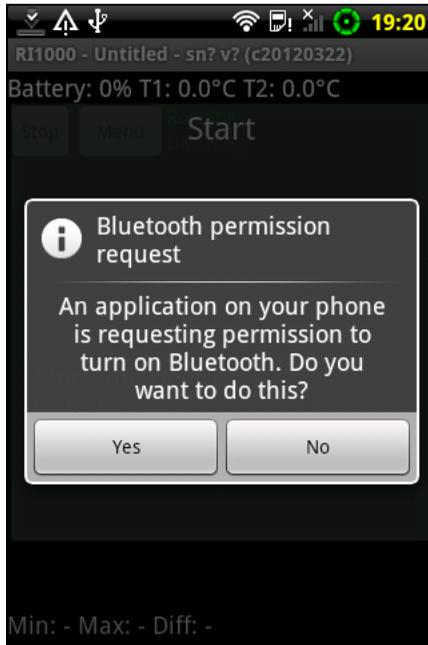
Fig. Nr. 3.2.   Default screen and screen after the start (START)

After touching the "START" button, the handheld computer is searching for available Bluetooth devices and establishes connection. Measurement results emerge right after the connection has been established.

Software is programmed to look for character chains like "RI" and "RID" in the names of Bluetooth devices found. Searching will continue when no Bluetooth device is found. The name of Bluetooth device serves for identification, the programme loads relevant calibration data from the device's directory (for example, the device named "RI0005 Bluetooth" has its calibration data stored in the directory named "SDCARD\devices\RI0005*").

Software informs operator with one of the following messages emerging on display instead of graphs.

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„Place the device onto the rail for measuring, please!"
There is no result to be displayed yet. Device gets information about the device lifted.

„Please, keep the device lifted up for a while!"
The measuring programme requires measurement value assessed while the device is held up. Operator should hold the device 20 mm above the rail surface as a minimum for about 4-5 seconds. When finished, device will give a sound and the following message appears on the screen: "Place the device onto the rail for measuring, please!"
When visualizing the measurement results, the one meter long measurement basis emerges on the horizontal axis while values of surface deviation from on one meter basis straight line are displayed in 'µm' resolution on the vertical axis. It's scaling changes within the range between +200..-200 µm and +1000..-3000 µm according to the actual measurement results. During the measurement, both maximum (Max:) and minimum (Min:) deviation values assessed as well as their difference (Diff:) on the 1/1000 mm scale are automatically displayed.

3.3 Presentation of measurement results

After device is switched on, but prior to RF communication, only the communication unit is working. Measurement device will start only after the communication has been established, data are being transferred continuously.
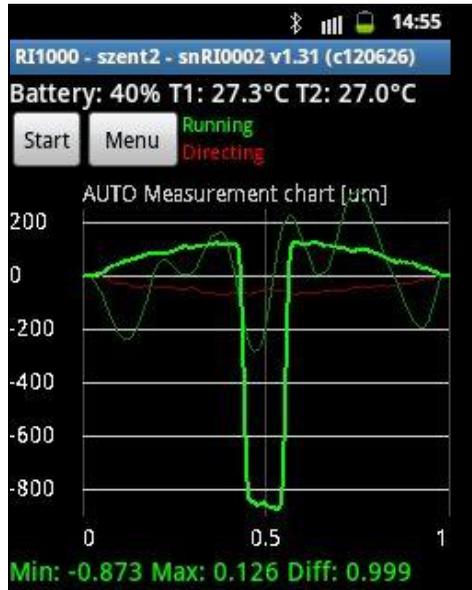Measurement results are visualized in both graphic and numeric format.

Fig. Nr. 3.3. Displaying the measurement results

The graph of the active measurement is blinking in graphic mode (line width of the graph is changing), its colour changes according to the surface checked. Colour changes to dark that indicates loaded measurement or measurement of a different surface. Green stands for the measurement of running surface, red is for that of the guiding surface. The one meter long measurement basis serves as horizontal axis, check the signs "0", "0.5" and "1" on the side panel of the device.

Vertical axis changes according to the value assessed between the minimum of +200... -200 µm and the maximum of +1000... -3000-µm.

Numeric data calculated from the measurement results appear in the side or the bottom of the screen according to its vertical or horizontal operation mode. Maximum (Max:) and minimum (Min:) deviation

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values calculated to the straight line as well as their difference (Diff:) appear in mm on the 1/1000 mm scale as displayed numeric data.
These data always refer to the active measurement that is visualized by a blinking graph (its line width is changing) among other graphs displayed.

3.4 Introducing the menu

Press the button "MENU" to open drop-down menu and select operation.

„Save"
This message only emerges when a measurement is ready to be saved (in other words: deviation between consecutive measurement processes becomes a minimum).
After touching this button, the measurement values are stored in the active project file in the SDCARD\projects\directory. In case no active project is available, a "New project" will start.

„Measures"
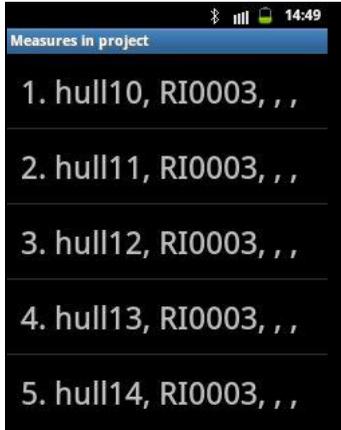Reports about a project opened that contains some measurements.

Fig. Nr. 3.4.a Selecting measurement from the active project

When this menu is active, measurement included in the active project will appear. Select the measurement and it emerges rather mealy on display. When searching among available measurements, their places of measurement appear first among saved input fields.
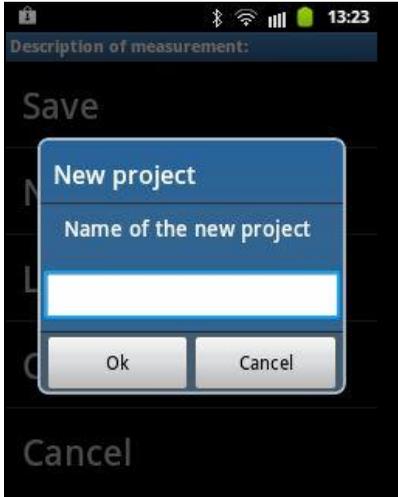

„New project"
Creating a new, empty project.

Fig. Nr. 3.4.b Creating a new project

The newly created project is the active project; it emerges on the top banner of the display. When touching the "Save" button, measurement is stored in this active project.

„Load project"
Opens a project file and loads one of the completed measurements or saves the new one.

Fig. Nr. 3.4.c Loading the Project

After touching the "Measures" button (loading the measurement), measurements are loaded from the selected project.

„Check device"
To check device, it should be placed onto the specimen for testing purposes. Proceed as described in chapter 6.1 of the guide of operation.

„Auto mode"
Turns automatic measurement mode ON/OFF. This menu item is applied when operator is unable to press the MENU/SAVE button to save the measurement (for example, when the guiding rail surface has been measured).
When "Auto mode" is switched on, touch the START button and lift device. Place device onto the rail after sound signal. After controlling continuous measurement data flow and if no more deviation is detected, device recognizes its position on the rail and stops the measurement after another sound signal. Operator may save measurement by touching the MENU/SAVE button or start new auto saving in "Auto mode" by touching the START button..

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„Auto save mode"
Similar operation as described under "Auto mode" with the difference that the automatically stored measurement is also saved together with the next consecutive numbering and is placed after the text previously entered in the field "Description" together with savings.

„Cancel"
Get back. Closes menu with no action.

Measurement results are stored after touching the "SAVE" button and entering input fields of the measurement.
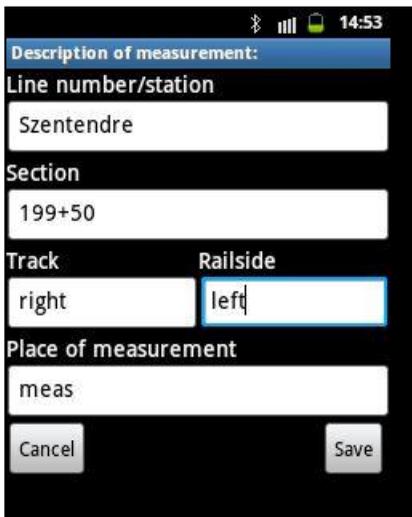
Fig. Nr. 3.4.d Input fields to be filled in when saving and report on successful data storage

Semicolon separated data are stored in the *.ritxt file created when saving the results of the measurement. The measuring file is easy to import and process (for example, by EXCEL database programme).

Fig. Nr. x. Files stored on SD card are also accessible using the file manager.

After saving, the graph of the stored results will be freezed in some dark colouring on the screen thus allowing a comparison with other measurement results. Also not saved values are easy to freeze on the display by touching the "STOP" button.

4. Perform a measurement

Prior to starting measurement in the selected rail sections, make sure to clean device's measurement screen and contact points as well as make a series of control measurement on the specimen for testing purposes as described under chapter 6.1.

4.1. Proceed with measurement

Device is to check straightness both the running and guiding surfaces of the rail on one meter long measurement basis.
Values automatically calculated out of the measurement values originating from 200 different points necessary for distance measurement, showing surface deviation from a straight line on one meter basis. As the distance between the two contact points is more than one meter, check marks on the side panel of the device for proper positioning when placing device onto the rail surface to be measured.

Direction of the measurement procedure.
Check the graph displayed using positioning marks on the device and the graph title on the horizontal axis of the measuring programme.
Attention!
Remember to turn device into proper position to perform measurement on the guiding surface of the rail. Measurement values in this case will appear on graph as a reverse.
Warning!
Pay attention to the fact that gauge extension leads to higher than expected measurement values.

What size of rail defects will fit?

There is a certain number of sensors built in to check the guiding and the running surface of the rail. Device is developed to check rail straightness defects sized bigger than one centimetre.

Lifting up the device
Follow instructions of the device ("Please, keep the device lifted up for a while!") and lift it up so that no material around is detected by the sensors (leave at least five centimetres distance).

Fig. Nr.4.1 "Please, keep the device lifted up for a while!"

Attention!
Keep device lifted up so that no material is detected.

How to fix hand-held computer?
There is a certain position to affix hand-held computer unit (either mobile phone or tablet PC) to the device housing. Use nano-pad to fix hand-held computer irrespectively of its format. Its working temperature range is between -24°C and +105°C.

Use medium warm tapping water to clean the nano-pad. Let it dry.
(For more information refer to the homepage of the manufacturer:
CLINGO.) Keep nano-pad with foil to protect when out of use.
Attention!
Remove hand-held computer from the device and cover nano-pad
with its foil prior to transport. Close carrying box.

4.2. Carry out a measurement in auto mode

Switch on/off auto mode by selecting Menu items "Auto mode" and
"Auto save mode". Check status above graph: „NORMAL","AUTO"

„Auto mode"
Turns auto mode of measurement ON/OFF. This menu item is
applied when operator is unable to press the MENU/SAVE button to
save the measurement (for example, when the guiding rail surface
has been measured)
When in "Auto mode", first touch the START button and lift device.
Place device onto the rail surface to be measured after sound signal.
After controlling continuous measurement data flow and if no more
deviation is detected, device recognizes its position on the rail and
stops the measurement after another sound signal. Operator may save
measurement by touching the MENU/SAVE button or start new auto
saving by touching the START button.

4.3. Measuring the guiding surface of the rail

When measuring the guiding surface of the rail, operator has to push
device against the guiding surface of the rail by pressing down both
ends of the device. As operators hands are busy, the hand-held
computer will guide the measurement process. Follow instructions in
chapter 4.2 to apply "Auto mode".

Fig. Nr. 4.3 Measuring the guiding surface of the rail

5. RI-1000 PC-s print programme

The hand-held computer unit (either mobile phone or tablet PC) of RI-1000 device to check rail surface straightness runs on Android operation system (OS). It saves measurement results in some projects. It is advisable to store relevant measurements in the same project, it facilitates both storing and processing of data. Each project contains two files with "*.ri" and "*.ritxt" extension stored in SD card \projects\ directory of the hand-held computer.

Files with "*.ri" extension are used either by the measurement programme or the print programme.

Files with *.ritxt extension contain all measurement results in text format, they are easy to export to other external applications (or database processing programmes like EXCEL). Measurements are displayed in columns separated by semicolon. The first column contains data about the measurement site on the 5 mm scale, others contain measurements in µm.

Data must be transferred to PC using either communication cable or the SD Card before starting print programme. Close programme pressing '←' back button before data transfer.

Use only „RI_PC.jar" file to start the print programme. Click „Open" after start and select the file to load.
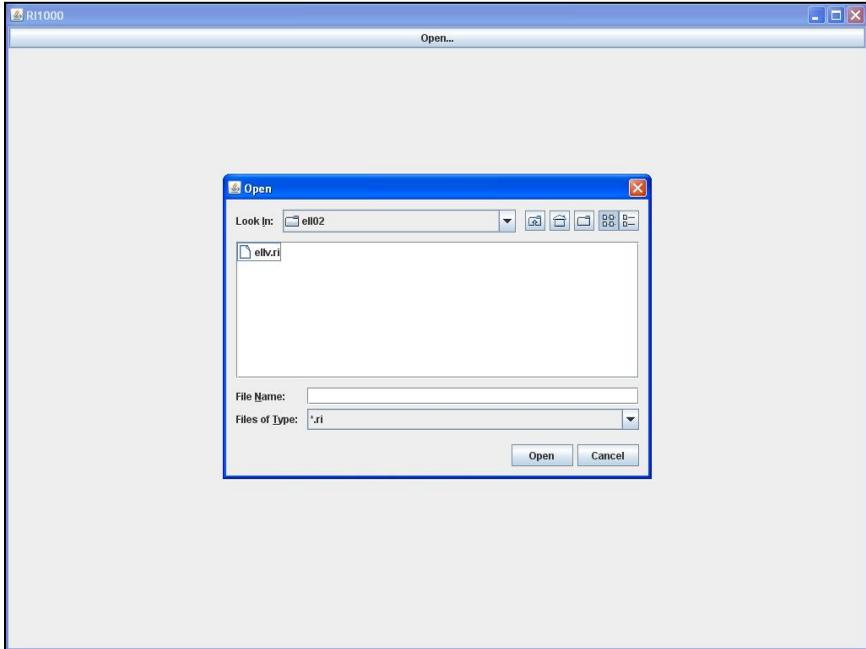
Fig. Nr.5.a Opening the measurement project file

After loading the project, each measurement appears on a different
page. Select measurement to be displayed on the left side above
graph, use buttons on the right to zoom.

Click on the rectangle above graph to select full screen mode and use
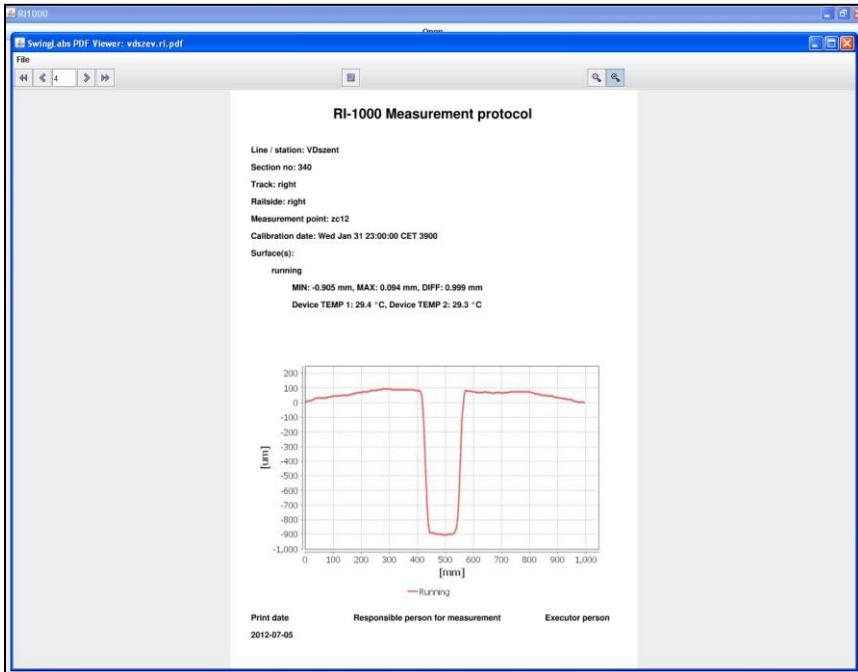„←" and „→" (left and right arrows) to view next measurement.

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Fig. Nr.5.b RI1000 print programme displays measurement results

Click on menu item „FILE/PRINT" to print measurement. All measurements are printed.

Programme can export a project to a .PDF file using the name of the loaded file with „*.ri" extension. Each measurement report included appears on a different page for comfortable printout.

Reports are printed in A4 portrait format.

Each measurement report contains data fields filled on the hand-held computer as well as the measurement results as in the form of a graph.

Also maximum and minimum values and the difference between them and the temperature values assessed are included. Attention! These temperatures originate from the outside and the inside of the device housing.

Printout date emerges at the bottom of the report that is to be signed by the operator and those in charge for the completion of the measurement.

6. Device maintenance

6.1 Device check

Device check is periodically performed by the user applying the specimen for testing purposes delivered together according to manufacturer's instructions.

During device check, measurement on the running surface of the rail is carried out. Software controls values and gives a warning message if the device is not allowed to put into operation. Exact device positioning is helped by marks on the specimen.
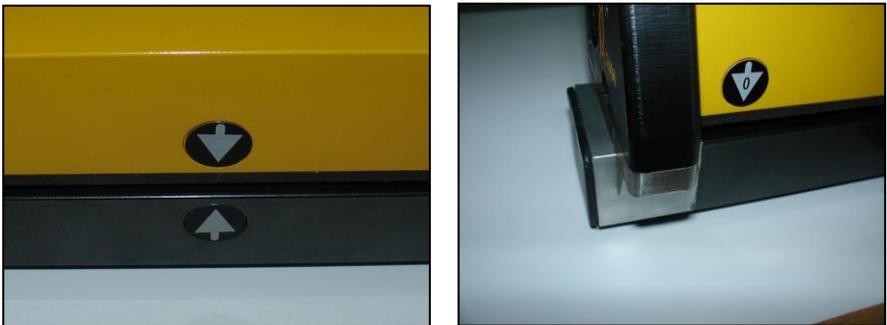

Fig. Nr. 6.1 Applying the specimen for testing purposes

Prior to starting measurement, make sure both the measurement screen and the specimen are clean. Clean them when necessary.

Steps of control:
1. Put specimen in a stable position.
2. Lie device in the position marked.
3. Switch on device.
4. Start measurement programme on the tablet PC or the mobile phone.
5. Start the measurement. (START button – searching for devices, connection)
6. Select menu item "" in the MENU.
7. Follow instructions of the measurement programme.

Fig. Nr. 6.2 Device control

If concluded measurement is considered by the programme as not perfect, make sure that no external influences like contamination on

surfaces involved in the measurement (device or rail) or bad contacts cause errors in operation.

6.2 Calibration

Device check is regularly performed by the manufacturer every 12 month or in the case the results of the control measurement makes it necessary. Remember delivering device back to manufacturer together with its specimen.

6.3 Replacement, charging and storing batteries

Display with 'battery discharged' status

Battery status is continuously displayed when the measuring programme runs. Battery status is displayed in percentage (0 - 100%) in the status line above the graph.

Operator receives a warning message in text format when battery discharge status falls below ten per cent.
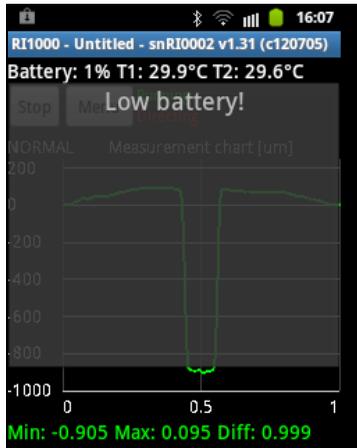
6.3.Fig. Nr. – Display with 'battery discharged' status

Touch the screen to confirm warning message about battery status. After five minutes elapsed, the operator gets again a warning message; provided the battery discharge status is still below ten per cent.

Device runs on two AA batteries or reachargeable batteries. Two batteries and one quick charger are supplied by the manufacturer. Battery status is displayed is percentage.
When battery is empty, no RF connection will be established. Green light in the middle of the ON/OFF switch indicating supply status becomes pale or even disappears.
Remove battery cover at the edge of device by turning it anti-clockwise to replace batteries. Slight lifting the other edge helps take out batteries.
Let batteries be charged using the quick charger supplied.
Charging cycles of batteries may vary depending on manufacturer, type and charger. As a matter of fact, storing capacity of batteries becomes less after 100-200 charging cycles even in the case the battery charger performs deep discharge.

After full recharge, insert batteries following instructions on battery cover (with negative end inside). Turn battery cover clockwise to fix it.

6.4 Cleaning the device

Use soft soaked clothes and avoid solvents when cleaning device.

Cleaning the measurement screen
Clean the measurement screen with most attention. Avoid cleaners with abrasive function and protect surface against mechanical influences.

Cleaning the contact points
Cleaning the contact points at the edges is also very important. Dirty or contaminated contact points may decrease accuracy or obstruct the measurement itself. Supports are usually used to adjust device to the guiding rail surface. Also check them for ferromagnetic contamination that badly influence intended use of the device.

6.5 Guarantee

Guarantee time is one year under normal conditions. Guarantee does not cover damages caused by:
- misuse or abuse
- abnormal working conditions
- mechanical influences
- vis major
Guarantee gets valid when guarantee seal is broken.

7. Troubleshooting

No green light goes on when pressing ON/OFF switch on the front panel.	Not enough energy to supply device. No battery inserted or battery discharged.
Measuring programme running on hand-held computer does not find device. No way to establish Bluetooth connection.	Switch device off and then on and try to establish RF connection. Check green light on the ON/OFF switch and also battery status
Device is positioned in instable position.	Check contact points.
After controlling measurement data, deviation does not disappear. Result cannot be saved (no SAVE menu item emerges)	Mechanical instability or bad electrical conduction on contact points detected.
Device failed to perform test on specimen.	Repeat check. If check again fails, contact service
Measurement software detected hardware disoperation	Contact service.

8. Technical information

Surface appropriate for check	steel and its alloys, aluminium and other electrically conductive material compositions
Measuring range	+1mm . . -3mm
Resolution	1μm
Accuracy *	20μm within the range between +1mm . . -1mm
Accuracy *	3 per cent between -1mm . . -3mm
Time needed for one measurement cycle	≈ 1 second
Operating temperature	-20°C . . +60°C
Quantity of sensors	200 pieces
Power supply	2 pc. AA battery or rechargeable battery
Operation period	min. 20 hours with batteries >2000mAh
Communication with the hand-held computer	via Bluetooth RF connection
Size	1050 x 60 x 60 mm
Weight	4kg

* above accuracy only available on dry and clean surface

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