

# SonoDur2 Instruction Manual

Portable UCI Hardness Testing System  
with  
Motorized and Hand-held Measuring Probes



This issue 04, 09/2016 applies to software version V1.15 and higher, SonoDur2.

Subject to technical alterations.

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**Attention:**

**WARNING:**

Before using the device, please read the following manual carefully, including safety instructions, provided in section “[Safety Information](#)”, [page 12](#).

## 2 Introduction

This instruction manual describes the hardness tester SonoDur2 with motorized and hand-held measuring probes for UCI hardness testing (Ultrasonic Contact Impedance).

### 2.1 Measuring Method

The hardness measurement by means of ultrasonic indirectly evaluates the indentation testing of the Vickers diamond and digitally displays the result immediately. The application of force can be implemented either motor-driven or manually against a spring. A hardness value is calculated at a defined force (penetration force), which correlates to the area of impression after indentation, although the measurement was carried out under load.

The UCI hardness testing is standardized according to ASTM A 1038, DIN 50159-1 and -2 and described in VDI / VDE Standards 2616, Sheet 1.

Thereby, it must be noted that the measurement result depends, among others, on the elastic properties of the test material and therefore, the measurement device must be calibrated onto the test material. Hence, the UCI hardness testing is representing a comparative method attributed to reference standards (calibrated or adjusted by the operator). The reference scale for the hardness testing is the Vickers unit (HV). Adjustment can be indirectly performed on hardness reference blocks or directly via comparative measurement, for instance, by means of a Vickers machine (identical test force) on a specimen of the test material.

If a different test method is being used (Rockwell, Brinell, etc.), shape and material of the indenter, indentation size and hence, the measuring range varies. Therefore, depending on the material, treatment and surface condition, adjustment or conversion of hardness values can be incorrect or inadmissible with one another as well as with tensile strength values.

Conversions from the calculated Vickers hardness values are therefore permitted with restrictions and only in accordance with relevant standards. All conversion tables in accordance with EN ISO 18265, ASTM E 140 are defined in the SonoDur2 tester. However, it's up to the responsible individual to decide about the admissibility of a conversion based on the calculated Vickers hardness on the basis of his specific requirements and experiences.

**Motorized measuring probes:** Based on the very low test forces between 1 N (HV0, 1) and 8.6 N (HV1), the measurements are virtually non-destructive at almost constantly low dispersion of measured values, even at high hardness levels. Thus, the main applications for motorized probes, production control and maintenance checks of smooth (polished, lapped) and thereby also coated surfaces (hard chrome, copper), such as rollers, rotogravure cylinders, automotive components and other components, are associated with high-level requirements pertaining to a clean and undamaged material surface. It is also very well possible to measure small spring components or other precious components, if a possible component vibration can be suppressed by holding or fastening the device properly.

**Hand-held measuring probes** with, for instance, test forces of 10N (HV1), 50N (HV 5) and 100N (HV10), have fewer roughness requirements. Therefore, the area of application is wider, also rather tends to very large and heavy components in hardening plants, for example, after induction hardening, on welding seams of boilers and pressure pipes. For the cutting edge assessment on

structural steel, HV10 measurements will become mandatory as of July 2012 in accordance with EN ISO 1090.

Further applications are described in the following:

**SONO-10H, 10N Test Load (HV1):**

In principle, all measurement tasks described under the SONO-8M motorized measuring probe can be accomplished. The smaller design enables improved accessibility, i.e. it is easier to measure components with more complex geometry from all directions - toothed wheels with a smaller number of modules, forming tools, thin-walled parts.

**SONO-50H, 50N Test Load (HV5):**

This probe is used most frequently in day-to-day operations, since it can be used not only on thinly coated components, but also on all components of the above described probes.

There are lower requirements on the surface characteristics than with all probes mentioned above, which allows to test more coarse grained materials as well.

In relation between surface condition and manual test force or manual control needed, the application is very well balanced.

**SONO-100H, 98N Test Load (HV10):**

Conversions in tensile strength of steel are possible here, for instance on hardened and tempered steels after flame or induction hardening - according to this standard, it does not apply below HV10 – in addition, conversions in the range of Rockwell and Brinell testing is more likely, since the surface portion decreases relative to the volume fraction of the measurement.

Rougher surfaces, such as cold work tool steel for stamping tools, embossing dies and stamps, forging jaws, sintered metals and high-strength vehicle components, are well suited for HV10 measurements.

Weld seam testing, in accordance with HV10 regulation, safety containers, etc.

**Information on the test loads:**

In publications and in our documents, the conversion from HV1, HV5, HV10, etc., is sometimes indicated in rounding numbers due to the conversion factor 1 kp (kgf) = 9.81 N in Newton, N is sometimes indicated as rounding number (HV 5 = 49N is frequently indicated with 50N and HV10 = 98 N with 100 N). But, the force is precisely adjusted in Newton, thus, for instance: 49N, 98N!

The test conditions in terms of surface characteristics (surface roughness) or layer thicknesses comply with the requirements of the traditional Vickers hardness measurement. At a HV1 measurement, the UCI standard DIN 50159-1/2 specifies a maximum roughness Ra of <0.5 µm, which corresponds to  $d \approx 10 - 20 \times Ra$  in relation to the penetration depth. Accordingly, with HV5 it comes to 0.8 µm and with HV 10 up to 1.0 µm.

In this context, penetration depth (d) and average diagonal length (Ld) can be determined by

$$d = 62 \times \sqrt{\frac{\text{Nominal Test Load [N]}}{\text{Hardness [HV]}}} [\mu\text{m}] \text{ and } Ld = 434,9 \sqrt{\frac{\text{Nominal Test Load [N]}}{\text{Hardness [HV]}}} [\mu\text{m}]$$

**Equation 2-1**



The table below shows a few examples of the more significant penetration depth (in “μm”):

Hardness	HV10	HV5	HV1	HV0.3	HV0.1
800 HV	22	15	7	4	2
600 HV	25	18	9	5	2,5
300 HV	36	25	11	6	4

**Table 2-1**

In general, the nature of the component surface in the range of low-load hardness testing, are of particular importance. High dispersion of measured values can be an indication of excessive surface roughness. In this case, reworking of the surface with suitable abrasives as well as a re-measurement may be recommended.

Some other influencing factors are summarized in the following:

- Minimum layer thickness: 10 x d (no noticeable influence by the base material after adjustment)
- Minimum material thickness without coupling: > 3 mm (component resonances can falsify measurement values)
- Minimum mass without coupling: > 0.3 kg (component resonances can falsify measurement values or may make it impossible to perform a measurement)
- Minimum distance from the component edge of the element = 3 x Ld, between the indentations = 6 x Ld
- The surface roughness should be much less as the penetration depth (< 1/5 x d)

In the latest issue of the German standard DIN 50159-1,2-2015 examples for the required surface roughness Ra for different test loads and as well for the grit size for the manual grinding work are given, see tables below:

Testload [N]	10	50	98
Ra [μm]	0,5	0,8	1,0
Ra [μm] ASTM	5	10	15

**Tabelle 2-2:** Guidelines for the maximum surface roughness according to EN ISO 6507 (Vickers) and information given in the standard ASTM A 1038

Sand paper grit size	120	180	240
Ra [μm]	1,2	1,0	0,6

**Tabelle 2-3:** Surface roughness after manual grinding using sand paper with various grit size (FEPA-Standard, „Federation of the European Producers of Abrasives“).

Besides surface roughness, material properties such as texture, mechanical tensions, layer structures and underground also play a role for measurement value variations and deviations from nominal values.

The above information is based on experience where the real practical situation has to be tested on the material and part in question.

The permissible limiting deviations for average values on hardness reference blocks apply in the assessment of measurement accuracy of UCI devices - refer to table below (from DIN 50159-1/2):

Hardness Scale	Limiting Deviation %			
	< 250 HV	250 HV – 500 HV	500 HV – 800 HV	> 800 HV
HV 0.1	6	7	8	9
HV 0.3	6	7	8	9
HV 0.8	5	5	6	7
HV 1	5	5	6	7
HV 5	5	5	5	5
HV 10	5	5	5	5

**Table 2-4**

All SonoDur2 probes must meet internal standards with max.  $\pm 3\%$  from 3 -5 measurements on hardness reference blocks (see [Technical Data – SonoDur2, Page 65](#)).

In accordance with the UCI standard DIN 50159-1/2, hardness reference blocks with specific dimensions are mandatory for the testing, namely a minimum thickness of 15mm and a diameter of 80mm. These blocks are often hardly obtainable. However, docking the hardness reference block to a flat hard surface, most preferably made of steel, has much higher significance than the "correct" dimension. Depending on the support material (wood, cloth, etc.), test force and test position, test reference blocks can develop macroscopically very complex panel vibrations that can complicate the performance of an UCI measurement or make it even impossible. Triangular Vickers hardness reference blocks with a thickness of 6 mm (see image below) are very much prone to panel vibrations and therefore it must definitely be ensured that these are always well coupled!



These triangle reference blocks need well coupling!

**Figure 2.1**

The best way to derive this type of influence is to observe the ranges of a measurement series. Depending on the probe and hardness, mean values are furthermore generally more or less significantly lower or higher than the indications provided on the reference block itself.

Caution is also needed on some Rockwell reference blocks (HRC), if they are only roughly grounded and therefore depending on the test force, may tend to indicate too low UCI hardness values.

Furthermore special care is to be taken when using hot isostatic pressed blocks are used (applied for some Leeb-Blocks) because of local scatter in Hardness or Young's modulus.

The surface of the test object must be definitely bare, free of surface coverage and scale as well as liquids. In addition, the test object may not move or vibrate when measurement is performed.

During the operation with induction hardening machines, measurements may must not be performed while a high-frequency field is present, since disturbances could occur or the measurement system may temporarily fail completely.

## 2.2 Safety Information

The SonoDur2 is manufactured and tested in accordance with the applicable safety regulations (EN 60950-1:2006, EC Low Voltage Directive) and has left the factory in a safety-related flawless condition. In order to maintain this condition and to ensure safe operation, please make sure you read the following safety information before you start using the device:

- UCI hardness measuring probes are highly accurate precision measurement instruments which may not, under any circumstances, be exposed to shocks or impact load!
- The device must be exclusively used for material testing, other applications, e.g. medical applications are not allowed!
- Keep measurement devices and accessories out of children's reach!
- The SONO-NG plug-in power supply unit may be used in dry areas only! Please do not use a power supply plug-in adaptor that is not approved for this product!
- The test device and/or plug-in power supply may no longer be used and need to be secured against unintentional commissioning, if
  - visible damages are apparent
  - the system no longer works properly
  - the device had been under extraordinary transportation stress
  - after prolonged storage under extremely unfavorable environmental conditions (temperature/humidity)
- Store and operate the test device and accessory only in the specific environmental conditions (temperature/humidity)!
- When used in commercial facilities, the accident prevention regulations of the professional trade association for electrical installations and equipment must be observed.
- Repairs may only be performed by authorized specialist staff.
- Never turn on the device/power supply unit, if the device/accessory is moved from a cold to a warm area. The generated condensation water may damage the device/accessory under unfavorable conditions! Leave the device/equipment switched off before it has been adjusted to room temperature.

## 2.3 Meaning of “Attention” and “Please note”



### Attention:

Ignoring these important facts can potentially lead to severe consequences.



### Please note

Information provided to make your work easier and to improve results.

## 2.4 Hardness Testing Requirements

An adequate training of operating personnel in the field of material testing is required in order to perform hardness measurements. This includes, for instance, adequate knowledge of:

- General hardness testing
- Effect of material characteristics on the hardness testing and selection of the measurement system
- Influence of surface condition
- Selection of test force
- Understanding about the comparability to other measurement methods, conversion.



### **Attention:**

Lack of knowledge may lead to incorrect test results and cause unforeseeable consequences!

### 3 Measurement Components

The SonoDur2 consists of a display unit and the herewith connected hardness measuring probe. The hardness measuring probe can be either motorized or hand-held, equipped with the relevant features to perform the required measurements. All probes will be attached to the display unit by USB interface with the cable that is firmly connected to the device. In contrast to other commonly used devices, the probe is equipped with a microcontroller that already performs the control system functions, raw data acquisition and signal processing inside the probe.

Hence, the probe can be easily integrated into almost any measurement system via a standard USB interface.

An overview of the scope of delivery and accessories can be found in the “Appendix” under “Section Scope of Delivery and Accessories”, page 61.

#### 3.1 Device Connections



Figure 3.1



### **Please note:**

**All connectors are polarized and can only connect to the device plug in one position.** When plugging the cable, it must be ensured that the cable plug is in the correct position towards the device plug (if necessary, determine by gently rotating it). In this position, the plug can be effortlessly slid by a few mm into the device plug. Only then, the plug can be clicked into place by pressing it down firmly - but without using any force. Otherwise, the plug connection may be damaged or destroyed!

Please make sure that the instructions for connecting the plug connector are definitely observed! ([Connecting and Disconnecting of the probe, Page 21](#))



### **Attention:**

If the plug is forcibly pushed into the connector socket, the entire connector system may be damaged, resulting in an unusable measurement system.

## **3.2 Initial Commissioning**

Each of our products is thoroughly inspected and carefully packed prior to delivery. However, please check that the shipment is complete and has not been damaged during transportation. (Please see also section [Safety Information, page 12](#) and [Scope of Delivery and Accessories, page 61](#)).

Before the first use, check the battery status and charge the instrument, if necessary. Insert the adapter into the SONO-NG plug-in power supply unit, as described in section [“Power Supply Unit”, page 16](#). Connect the micro USB plug with the device (be careful!) and the bigger rectangular USB plug with the power supply unit.



### **Attention:**

All connectors can only be inserted one way into the jack. Do not, under any circumstances, use force since the connector system may get damaged.

Plug in the power supply unit into the mains. Switch on the instrument as described in [chapter Turning On and Off, page 20](#). Start the SonoDur program by pressing the start button (see Description of Control Elements, page 24). The instrument is ready for taking measurements.

## 4 Power Supply

The SonoDur2 instrument is featured with an user exchange Lithium-Ion (Li-ion) rechargeable battery pack (3.7V / 2600mAh). The battery pack can be charged in the instrument or external in the docking station. The SONO-NG plug-in power supply unit can be connected to the USB plug connector in order to supply power.

### 4.1 Power Supply Unit

The SONO NG power supply unit automatically adapts itself to all alternating voltages between 90 and 264 VAC (50 /60 Hz). By default, the power supply unit is equipped with alternating voltage adapter when delivered. However, you can simply replace it with a different one. (Please also see Section Scope of Delivery and Accessories): In order to do this, press the unlock button (1) and disconnect the adapter. Slide in the desired adapter into the indentation until it clicks.



Figure 4.1



Figure 4.2

Depending on the state of charge, the battery will be automatically charged when connected to the power supply unit. You can let the power supply unit plugged in without any concern, even after the batteries are fully charged, since overloading is out of question.

### 4.2 Exchange Battery Pack



#### Attention:

Please don't remove the battery pack or try to take this PDA apart while the SonoDur2 is charging or the instrument is powered on. These actions will result in some damages and may invalidate your warranty!



The battery pack can be easily exchanged by opening the rear battery cover. Please follow the instructions given in pictures below.

Unlock the two quick fastener and lift the cover. Pull the plastic strip on the battery and remove it.

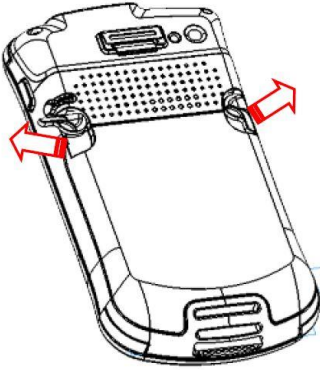


Figure 4.3



Figure 4.4



Figure 4.5

Re-insert the battery block by latching the bottom first and then pull it down. Mount the cover (make sure the latches of the cover fit in the mounting holes) and lock the two quick fastener.

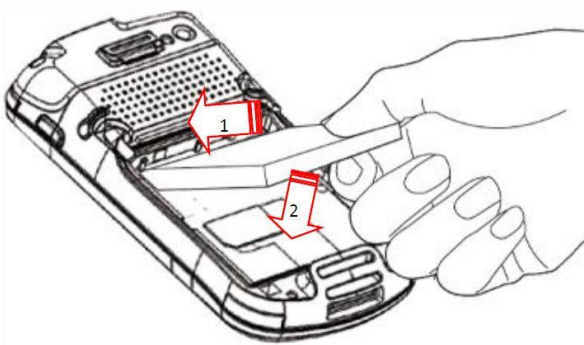


Figure 4.6

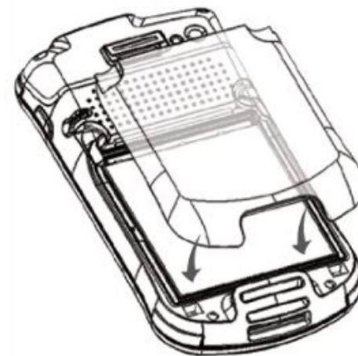


Figure 4.7

### 4.3 Charging

When charging, the tester must be connected to the SONO-NG power supply unit by means of the SONO-USB power cable. Charging of a completely discharged accumulator to 80% capacity takes up to 2 hour and up to 4 hours to 100% capacity when using the SONO-NG.



#### **Please note:**

Do not use any other USB-cables, because the plug may fit but will not make stable electrical connection!

If the SonoDur2 is connected to a USB port of a PC/laptop, charging is only possible when the instrument is turned off! Nevertheless charging time increases significantly because the USB port could only supply limited power.



**Please note:**

During on state, the USB-port is not able to deliver enough power to charge the battery pack.

Fully discharged batteries or deep-discharged cells (due to prolonged storage) must be charged by means of the SONO-NG. A connection to a USB port would result in a shutdown of the USB port due to the high charging current level!

Prior to initial operation, the SonoDur2 hardness tester should be connected at least 4 hours to the SONO-NG battery charger.



**Attention:**

Please also observe our safety guidelines under “Section Safety Information“, page 12.

In order to ensure a long life of the block battery, please follow the instructions below:

- After the device has been used for the first time, we recommend to fully charge/discharge the battery between 2 and 3 times.
- Please use the device only within the specified temperature range (see section “Technical Data – SonoDur2“, page 65)!
- The battery life is greatly reduced at higher ambient temperatures. Optimum charging takes place at temperatures between 0°C and 25°C. We therefore recommend unplugging the power supply unit at higher temperatures.
- Please prevent the batteries from becoming completely discharged. You may even charge the device more frequently, since it does not harm the capacity of the battery!
- Avoid storage at high temperatures, for instance, don't leave the device in your car during summer!
- If you keep the device out of service for a prolonged time, charge the battery pack and store the device in a dry and cool place.



**Please note:**

Remove the USB cable SONO USB from the device, if voltage is not supplied to the power supply unit or USB port. The SonoDur2 could become discharged!

## 4.4 Operating Time

The operating time decisively depends on the selected mode, ambient temperature, maintenance condition and battery's age. Therefore, only a typical operating time can be specified, which however cannot be guaranteed for the stated reasons.

Operation time for SonoDur2 is  $\geq 8$  hours under normal operating conditions and up to 6 hours continuous operating time.

Once the error message "Main Battery Low" appears or the battery indicator flashes red, the current series of measurements should be completed and the SonoDur2 must be connected with the SONO-NG plug-in power supply for charging or the battery pack must be exchanged.

### 4.4.1 Querying of Battery Capacity

The battery status can be queried at any time by touching the status bar and then touching the battery symbol. By acknowledging the OK button or by pressing the upper left button, you will be returned to the program.

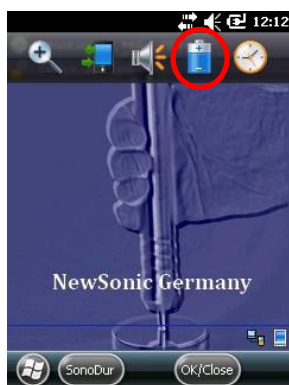


Figure 4.8

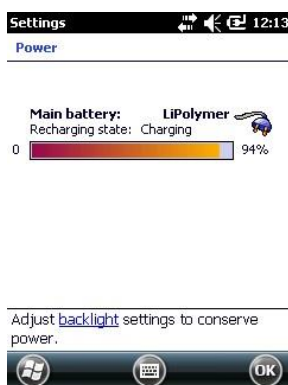


Figure 4.9

## 5 Turning On and Off

The device is turned on/off via the power button (bottom left most position of the keypad, see [Figure 5.1](#)). To turn on the device, press and hold the key (3-4 sec) until you will feel a slight vibration and the display shows the boot logo, release the key. After approx. 20 sec. the boot sequence is finished and the start screen is shown, see [Figure 5.2](#).

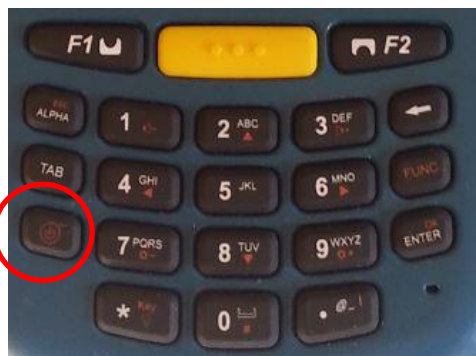


Figure 5.1

To start the SonoDur program, please press the function key F1 or touch the SonoDur icon on the touch screen, refer to chapter [Turning On and Off, page 20](#).

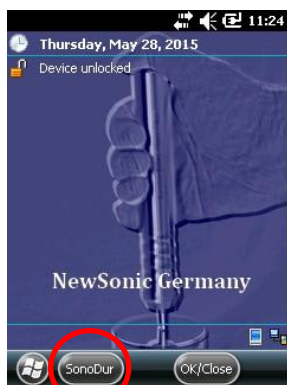


Figure 5.2

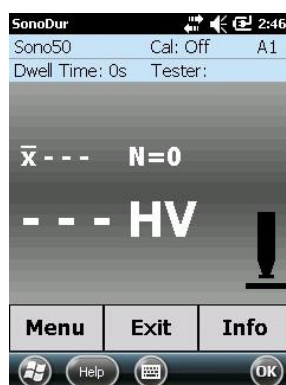


Figure 5.3



Figure 5.4

After the instrument has powered on, pressing the power button again will pop up the shutdown menu. Touching the red power off icon on the screen will switch off the instrument ([Figure 5.4](#)).

**Close the SonoDur program before switch off to avoid data loss!**



### Please note:

Please connect or disconnect probes only when the instrument is switched. Otherwise the instrument may not recognize the probe and the message “COM6: is not the virtual USB-interface...” will be displayed ([Figure 6.1](#)). In this case the instrument should be switched off and on again.

You can also force the instrument to shut down at any time by holding the power button for approximately 8 seconds until the instrument switches off.

## 6 Connect and Disconnect Probe

The probes are connected to the SonoDur2 through a shielded connection cable. The silver metal plug is a locking connector in accordance with the push-pull principle: When inserting the connector, 3 claws securely lock the connector into the jack. **Releasing is only possible by pulling back the outer sleeve of the plug which releases the locking claws!**

Please connect or disconnect probes only when the instrument is switched off or the application is closed! Otherwise the instrument may not recognize the probe and the message "COM6: is not the virtual USB-interface...." (Figure 6.1).

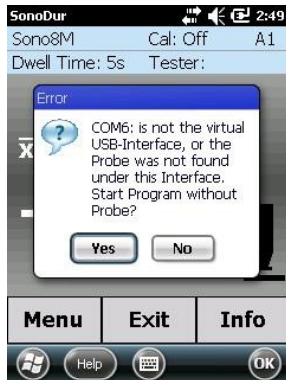


Figure 6.1

In this case the instrument should be switched off and on again.



### Attention:

The connector has a contact arrangement, which allows the connection in only one position. All connectors can only be inserted one way into the jack. Do not, under any circumstances, use force since the connector system may get damaged.

### 6.1 Connect Probe

Carefully slide the silver metal plug into the probe socket and rotate until the plug has reached the correct position and can be smoothly pushed into the socket. Locking is indicated by a "Click". The connector is now firmly locked with the jack through 3 claws.

### 6.2 Disconnect Probe

Unlock the silver probe connector by pulling back the sleeve and pulling it out of the jack.



### Please note:

The probe should not be connect or disconnect from the instrument during operation!

### 6.3 Removing Probe Connector during Operation

If the probe connector is removed during operation, the program SonoDur2 will be closed. After starting the SonoDur again, the message “COM6: is not the virtual USB-interface....” may appear (see [Figure 6.2](#)). In this case the system may not recognize the probe and SonoDur2 should be switched off and on again to rescan the USB-ports.

### 6.4 Operating without Probe – Simulation Mode

The device is equipped with a special feature when turning it on without a connected probe: The simulation mode makes it possible to test all functions of the SonoDur2 measurement program, without having to perform self-measurements with probes.

“Measurement Values” will now be generated by touching the probe symbol (see [Figure 6.3](#)) and all functions in connection with the testing procedure can be operated – a special way of fast training for operators and also to give presentations to all those who are interested.

Start program without probe:

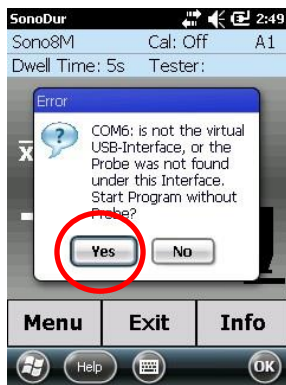


Figure 6.2

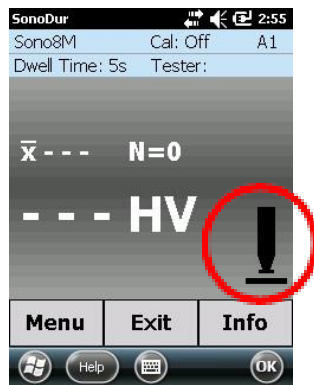


Figure 6.3

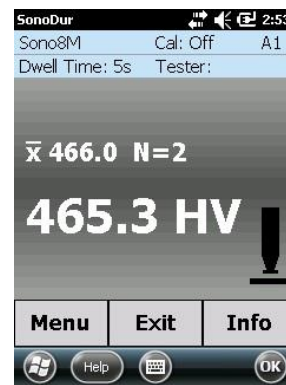


Figure 6.4

For returning to normal operation please follow the instructions below:

- Terminate the SonoDur Program by pressing the “EXIT” button or the “OK” key in the upper right corner of the display (in this case the program will not ask for saving data and be terminated immediately).
- Switch of the instrument
- Connect a probe
- Switch on the instrument
- Re-start the SonoDur2 program via Start -> SonoDur (or with the function key , see [chapter Control Elements 7.1, page 23](#))



## 7 Operation

### 7.1 Control Elements

The SonoDur2 is operated via the keypad and touch-sensitive fields on the screen ("soft keys"). These soft keys can be labeled fields, round buttons or symbols, numbers or figures and are activated by soft touching the screen. Additional functions are available via the 3 function keys.



Figure 7.1



#### Attention:

CAUTION! Never use anything other than the stylus on the touch screen. Otherwise this could cause a permanent damage.

### 7.1.1 Operating Structure

The SonoDur2 basically provides two-level operation, the measurement menu (**Figure 7.2**) and the instrument menu (**Figure 7.3**).

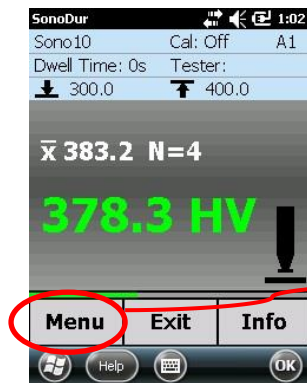


Figure 7.2



Figure 7.3

### 7.1.2 Description of Control Elements

Changeovers between the menus are performed via touch-sensitive menu buttons at the lower edge of the screen or symbols or tiles.

#### Menu

Changeover to the Instrument Menu.

#### Exit

1. Exiting the Measurement Menu, end of the measurement series
2. Exiting any sub-program within the Instrument Menu and changeover into the Measurement Menu
3. Closing SonoDur2 (after processing the last measuring series and prior to the first new measurement value).

#### Info

Display device settings for the measurement process, display of measurement results such as statistics, single values and corresponding correction possibilities.

#### Forward

Call up “green” highlighted menu item and take one step forward within the sub-menu.

#### Back

Go back one step within the sub-menu.

#### File (within the “Info” sub-menu)

Activating and displaying of stored measurement data.



## 7.2 Soft Keys

By touching the screen within the Measurement menu, direct changeovers to specific sub-menus can take place. See next table and for functions of the touchable symbols/tiles.

Symbol / Tile	Remark	Actual	Direct access to
<b>Sono8M</b>	Attached motorized probe, 3N test force	Sono3M	measurement method selection
<b>Cal: Off</b>	Adjustment off, standard adjustment for mild steel	Off	Adjustment settings
<b>A1</b>	Short cut for material table	A1	Material table setting
<b>Dwell Time: 5s</b>	Indentation time set to 5 sec	5s	Dwell time setting
<b>Tester: NewSonic</b>	Name of the tester	NewSonic	Tester setting
<b>↓ 230.0</b>	Lower threshold	500	Threshold setting
<b>↑ 260.0</b>	Upper threshold	550	Threshold setting
<b><math>\bar{x}</math> 250.8</b>	Mean value	518	Info menu
<b>N=3</b>	Number of measurements	3	Info menu
<b>251.4</b>	Actual (last) measurement	520	Delete reading yes/no
<b>HV</b>	Hardness Scale	HV	Hardness scale selection
<b>Menu</b>	Opens the instrument menu		Instrument menu
<b>Exit</b>	Exits from the SonoDur2 program, or jumps back to the measuring menu from any sub-menus		Measurement menu, end program
<b>Info</b>	Opens the information menu		Information menu

Table 7-1

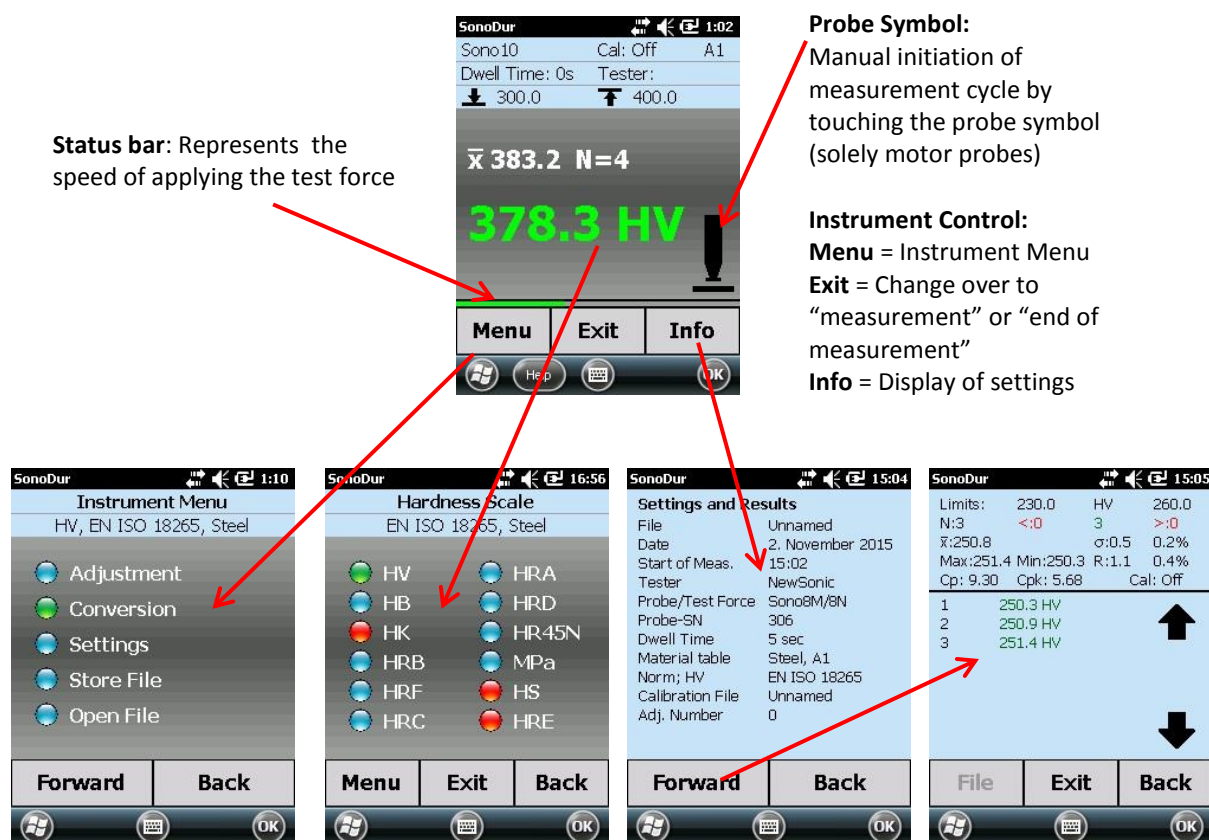


Figure 7.4

### 7.3 Entries via System Keyboard or SonoDur2 Keyboard

Any position inside the input field can be marked, modified or supplemented. The keyboard can be accessed by clicking the keyboard symbol at the lower bottom of the screen. Numbers can be entered via the large SonoDur2 keyboard: Number field, horizontal arrow as delete key (individual symbols on the left hand side in order to place the cursor) and decimal point.

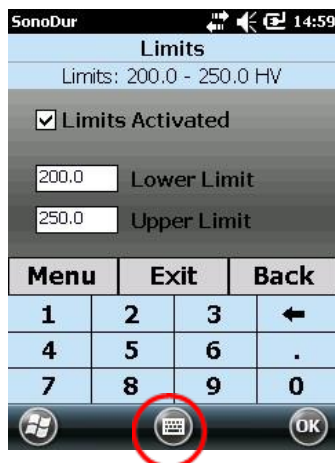


Figure 7.5

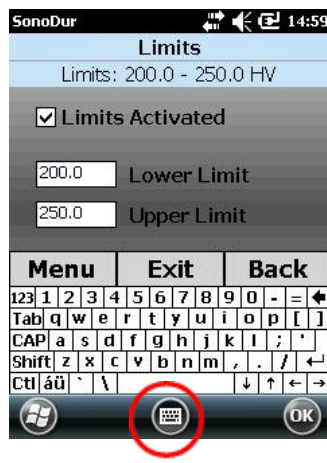


Figure 7.6

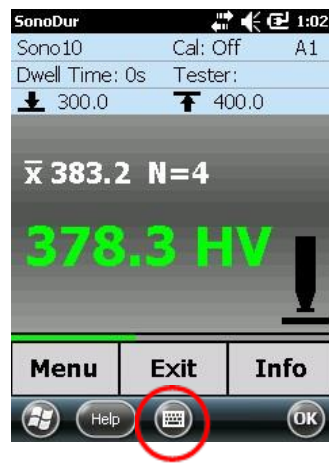


Figure 7.7

Switching between keyboards by means of the keyboard symbol, show or hide keyboard.

### 7.4 Main Menu Measurement

The SonoDur2 test device must be in the main menu “Measurement“, to enable the accomplishment of a measurement. The Measurement menu can be accessed from any program item via the **Exit** button. The operation with motorized- and handheld probes is described below. If a handheld probe is used, a horizontal bar is displayed over the softkeys Menu, Exit and Info. The bar represents the velocity of applying the test force. This information should help the user to find the right handling of the probe! A short bar (left end)=test force is applied too fast, middle (green bar)=ok, long bar (right end)=applied test force too slow (refer Figure 7.11 to Figure 7.13).



Figure 7.8



Figure 7.9



Figure 7.10

### 7.4.1 Carrying out of Measurement by Means of Motorized Probes

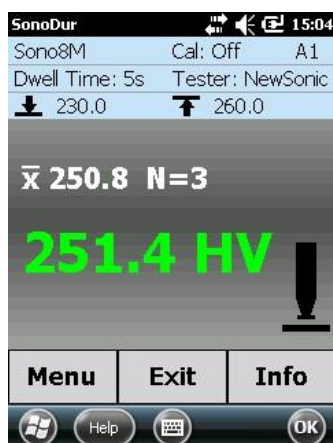


Figure 7.11



Figure 7.12

Measurement menu and probe guidance during the performance of a measurement: As shown in the image above, it is recommended to hold the probe on the bottom of the probe base during the penetration phase in order to prevent it from tipping over. This risk is particularly high, if the probe is only held on the top.

### 7.4.2 Automatic Measurement with Probe Shoe and Switching Sleeve:

Carefully attach the SonaDur2 motorized probe (Figure 7.12), keep it pressed down and wait until the measurement process is completed. When the probe touches down, the switching sleeve (Figure 7.19) will be pressed backwards, triggering the motor control through a micro-switch. The Vickers diamond will be automatically moved from the casing towards the material surface. This process is indicated by a directional arrow in the probe symbol of the device display (Figure 7.13). As soon as the nominal test force has been reached, the probe symbol will be replaced by the remaining penetration time (units, indicated in seconds) and the countdown starts to run. Once the preset penetration time has expired, the measured value will be indicated and the reverse engine movement simultaneously displayed by an arrow in the opposite direction, until the end position has been reached (see picture sequence below).

It is recommended to not raise the motorized measuring probe for the next measurement beforehand. In this way, potential surface damages by the retracting Vickers diamond can be definitely avoided.

In either case, a new measurement cannot be triggered until the end position had been reached.



#### **Please note:**

If the Vickers diamond was not able to touch the material surface no reading will be taken and the motor drives the rod back in parking position.



Figure 7.13



Figure 7.14



Figure 7.15

Figure 7.13 until Figure 7.15: Probe movement, countdown of penetration time (in this case, 2 sec), probe moves up until end point is reached.

When the probe shoe is unscrewed (Figure 7.16), the switching sleeve protrudes approximately 5 mm from the casing and starts the motor once it is placed on the material surface (automatic measurement) by activating the micro switch (red circle). Figure 7.17 show manual measurements with free vibrating rod or by unscrewing a protective sleeve (Figure 7.18) for measurements in places with difficult access.



Figure 7.16

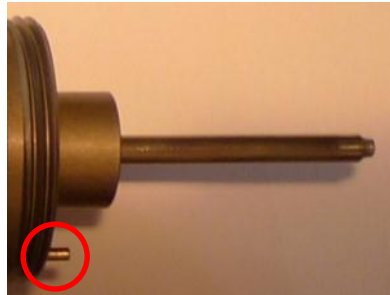


Figure 7.17

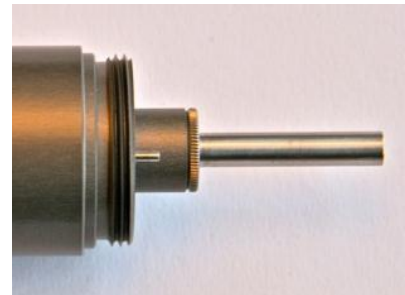


Figure 7.18

#### 7.4.3 Manual Measurement without Switching Sleeve:

After removing the switching sleeve, (in the picture on the left, [Figure 7.19](#)) the measurement will be started by touching the probe symbol on the SonoDur2 display or by pressing and holding the micro-switch.



[Figure 7.19](#)

#### Example – Measurements with Probe Shoe:

Measurement points can be set in close distance from each other without lifting the motorized probe. After reaching the upper position (end position) of the Vickers diamond, slightly shifting the probe and touching the probe symbol on the device is sufficient in order to take a new measurement.



#### **Attention:**

In order to prevent damages to the surface or to the Vickers diamond as a result of shifting the probe too soon, it is absolutely required to wait until the upper probe position has been reached!

#### Example – Motorized Measurements without Probe Shoe:

In this configuration, however, the vibrating rod of the motorized probe, is free and can be easily damaged by careless handling ([Figure 7.17](#)). This configuration is only recommended, when operating with a stand, good probe guidance and defined distance between probe tip and test object or by very well trained and experienced operating personnel. By unscrewing the protection sleeve, the probe rod is optimally protected against mechanical damages ([Figure 7.18](#)). However, stable probe guidance is also required in this case.

In both cases, the measurement is triggered via touch screen command or by pressing the micro-switch on the underside of the probe.

#### Free Measurements with Protection Sleeve:

The probe is gently placed onto the test object, and the measurement commences. It must thereby be ensured that the probe will not be tilted during the measurement phase. After the measuring time has lapsed, the vibrating rod returns to its initial position.

When performing such manually operated measurements, it can easily happen that a slight tilting of the probe occurs during the motor movement. This is due to the small surface area of the circular protective tube. Hence, the hardness measurement value could be indicated too low. This effect can be avoided by pressing firmly on the test object surface with both hands and keeping it still, after the probe has been placed. Another possibility is to only hold it softly at first, so that the motor is



pushing the probe slightly upwards, once it moves outside. At the end of the motor movement, the operator can gently press against it with his hand and reattach the probe protective tube onto the test object without any great effort. The measuring time should be as short as possible, for instance, 1 or at maximum of 2 seconds. In this way, the effect of tilting will be minimized in both cases. As in all manual measurements, this procedure requires a certain amount of practice and patience.

#### **Free Measurements with Free Vibrating Rod:**



#### **Attention:**

**This testing guidance requires extensive training on hardness reference blocks and should be only performed by experienced operators!**

When taking measurements with a free vibrating rod (Figure 7.17), it should be proceeded in such a way, that the penetration time is initially set to 1 second. Preferably, the probe is held perpendicular to the test surface with one hand. At first, the vibrating rod does not touch the surface, i.e. it directly sticks out above the material surface into the air (this task is normally fulfilled by the protective tube). The motor movement will now be commenced with the other hand by tapping the probe symbol on the SonoDur2 device and the probe carefully placed and held with the diamond tip onto the test object. As soon as the diamond touches the material surface, the motor will press against the operator's hand. The operator has to keep still and press against it, until the measurement time has elapsed and the motor retracts again.

#### **Example: Manual Measurements without Motor and without Probe Coupler:**

In the device menu Settings (Figure 7.20 and Figure 7.21), the manual measurement mode with lifted probe tip (approximately 4 mm) can be selected. This is indicated in the Measurement menu by "Manually operated" (up to V1.07 it is named Hands-free) at the top left corner (Figure 7.22) - by tapping on it, you will also get directly into the selection menu "Manually operated" (Figure 7.21). Once the operator manually pushes the vibrating rod carefully on the test material, a hardness measurement will be taken. Shortly after the contact with the test object has taken place, the penetration time starts to count down and the measurement will be triggered.

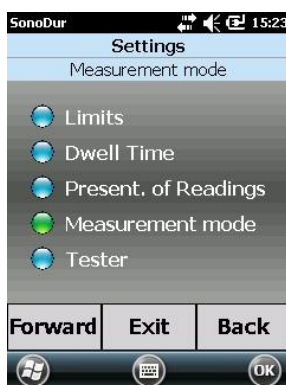


Figure 7.20

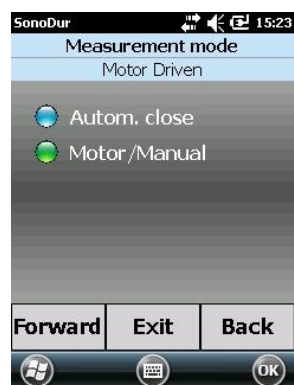


Figure 7.21



Figure 7.22

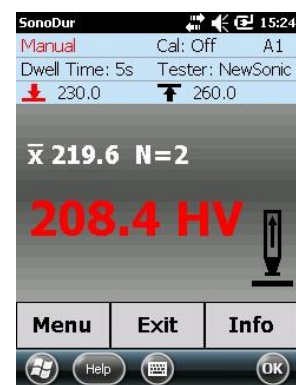


Figure 7.23

As soon as the manual measurement is completed, an arrow will be shown on the display, indicating that the probe should be raised (Figure 7.23). When measuring without a protective sleeve, the vibrating rod is carefully attached by hand and the probe is pushed down slightly (approximately 3 - 4 mm) and held until the measurement time has lapsed (1 or a maximum of 2 seconds). Also in this case, an extensive practical training is recommended.

#### 7.4.4 Performing a Measurement by Means of Hand-held Probes

The performance of measurements is only possible, if the SonoDur2 display device is set to the measurement mode. The test force has to be applied manually against a spring in the probe casing. As a general rule, the forces are significantly higher than when using motorized probes (HV1-10N, 50N-HV 5 or HV 10-100N) and the spring is already strongly pre-stressed, so that the nominal test force will be reached after a very short distance – approx. 3 mm penetration path back into the housing. This requires an extremely careful handling of hand-held probes in order to prevent damage to the diamond if it touches the surface too hard!



#### **Please note:**

**Dwell time is set fixed to zero (will be set automatically if a hand-held probe is detected) and has to be verified before measuring!**

This is the proper way to proceed:

- 1.) Carefully attach it preferably perpendicular to the test object surface – the contact signal appears in the display
- 2.) Press the probe gently and continuously on the material until the probe attachment sleeve slightly touches the test object surface or - if the probe attachment sleeve is unscrewed - until the end stop inside the probe casing has been reached. Thereby, always keep an eye on the probe or the test position since the device display only shows the old measurement value!
- 3.) When gently pressed, the nominal test force will be already reached before the end position and the hardness value will be immediately calculated from the measured frequency shift – **raise the probe and only now read the measurement value!**

**It is absolutely unnecessary and also hazardous to press hard and long time because the measurement has already been performed long before the end stop is reached.** It is also not required to perform the test sequence within a short period of time limit as it is possibly need to be done with any other hardness testers. On the contrary: **It is advisable to leave yourself enough time in order to perform the entire process slowly and in a controlled manner.** In this way, overloads or damages to the diamond can be prevented. The probes behave extraordinarily good-natured and any operator influence is hardly felt. In addition, the measurement results are direction independent.

With the above method, exact measuring results can be achieved after a short training, which otherwise can be only achieved by means of additional guidance supports or support stands.



Figure 7.24



Figure 7.25



Figure 7.26

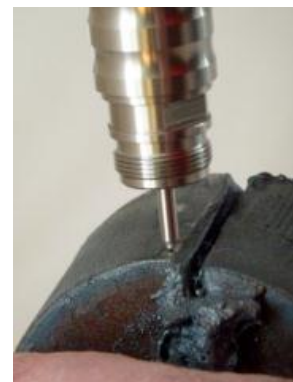


Figure 7.27

The force should be exclusively applied starting from the probe closure head via the palm of the hand or the thumb. Other fingers are solely there for the probe guidance free of side-forces. A second hand can serve for this purpose as well. In any case the force vector must point into the direction of the oscillation rod axes in order to avoid disturbances by lateral forces. When the probe attachment sleeve is unscrewed, small and narrow test positions can be also securely measured (see [Figure 7.27](#), SONO-100H, HV10 to test cutting edges on construction steel according to EN ISO 1090).

## 7.5 Information Menu

Display of current device settings, statistic and processing of measurement data.

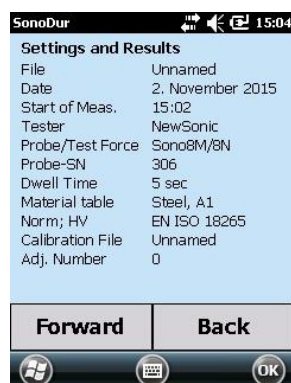


Figure 7.28

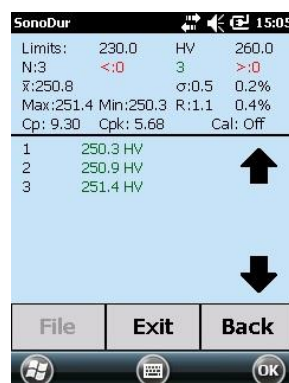


Figure 7.29

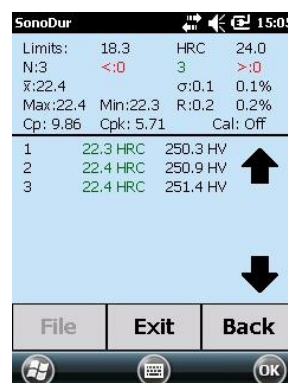


Figure 7.30

All relevant information is displayed at a glance ([Figure 7.28](#)) and via "Forward" button, one receives information on the measurement results ([Figure 7.29](#) and [Figure 7.30](#)). [Figure 7.30](#) shows the same result as [Figure 7.29](#) with the only difference, that the original measurement values (HV) have been converted to HRC, whereas the results of the original scale are always carried along for information purpose. The relevant tolerance thresholds will be automatically converted from the original scale to the re-evaluated hardness scale along with the summarized results for the average value, overline X, mean error of individual measurement  $\sigma$ , range R, minimum and maximum.

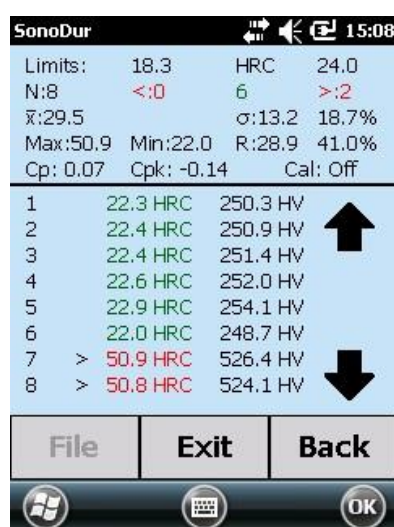


Figure 7.31

Interpretation of results (in this case, in HRC):

**Thresholds:** Minimum, maximum, hardness unit HRC

**Measurement quantity N** = "8", thereof "6" measurements within the tolerance range, "2" above, "0" below.

**Average value**, overline X = 29.5 HRC,  $\sigma$  = 13.2 HV or 18.7 % of overline X

**Extreme values:** Max = 50.9 HRC, Min = 22.0 HRC, R = 28.9 HRC or 41.0 % of overline X

**Process parameters:** Cp = 0.07 or Cpk = -0.14; Cal= off (dimensionless, standard steel)

**Individual results:** Green = Ok, Red = beyond tolerance, > = above and < = below, X = deleted, Black = Vickers values for comparison.

Please see Appendix for further explanations on terms and formulas ([Formulas and Terms, page 68](#)).



Correction of measurement results by tapping on a measurement value (in this case: No. 7, 50.8 HRC, **Figure 7.32**) by confirming (Yes/No) or recovery of deleted measurement values (in this case: Same measurement value 50.8 HRC, former measuring point, No. 7, **Figure 7.34**). Any Measurement values can be deleted or restored after analysis has been performed. The statistic results are updated and newly calculated for each condition.

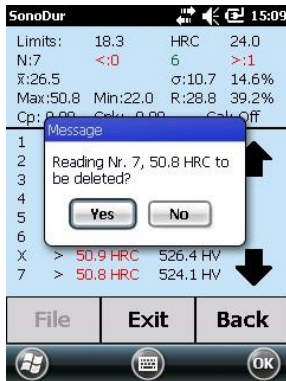


Figure 7.32

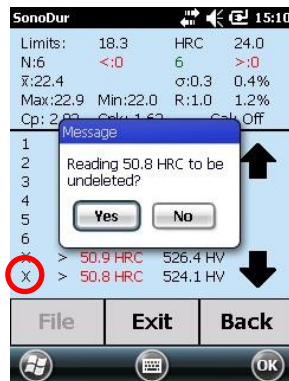


Figure 7.33

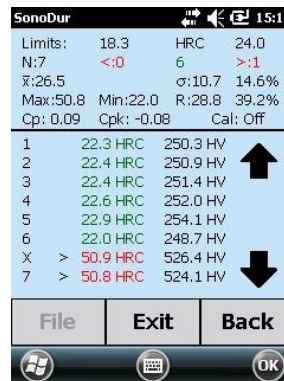


Figure 7.34



### Please note:

Deleted measurements are marked with a “X” in the position row (see **Figure 7.33**, red circle) and will still be shown, but not taken account of in the statistic calculations!

This deleted data can be restored. After re-storage the value will appear at the same position and the statistic will be re-calculated.

## 7.6 Device Menu

The device menu can be accessed via the **Menu** button with access to all instrument parameters, the data logger and the adjustment function.



Figure 7.35

Additional program steps are indicated in plain text with the aforesaid colored dots:

**Green:** Will be executed by the “Forward” button

**Blue:** Is available as menu item

**Red:** Is not available as menu item

By tapping a blue highlighted menu item, the item will become highlighted in green and executed via the “Forward” button.

Within the new menu item, the name of the menu item and the currently selected setting will appear once again on the top of the status bar.

## 7.7 Adjustment

This is where the measuring system can be adjusted to the test material by determining a setting value containing the material properties (modulus of elasticity deviating from low-alloy steel) and applies to the specified test method. This setting value depends on the test load, probe type (hand-held or motorized measuring probe) and on the frequency sweep (penetration time and measurement direction). Stored adjustments only apply to the specific probe type.

The adjustment is carried out via the subprogram "Adjust Measurement Value", in which the setting value is directly determined through a direct adjustment measurement on the test object or via "Setting Value Directly" by entering the setting value without performing a adjustment measurement, whereas all measurement values will be immediately recalculated by using this new setting value.

### 7.7.1 Adjust Measurement Value

If a measurement series has been recorded, one can choose between two adjustment options, which are described under a) and b). Then the system will ask whether the result (average value) of the already recorded readings already recorded, should be used for the adjustment (see [Figure 7.38](#)).



Figure 7.36



Figure 7.37

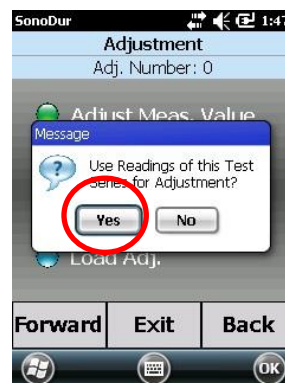


Figure 7.38

- a.) "YES": The determined average value will be immediately indicated in the "Reading" (measurement value) field as well as in the "Reference Value" (nominal value) field. The desired reference hardness value can now be entered here via the keyboard ([Figure 7.39](#)).

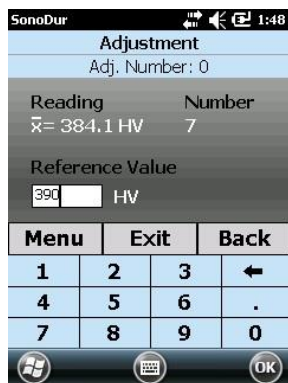


Figure 7.39

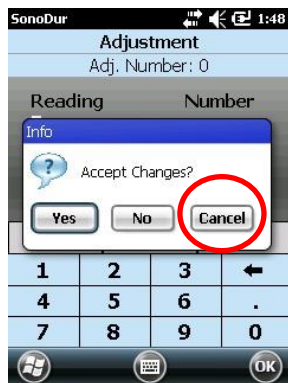


Figure 7.40



Figure 7.41



Figure 7.42

Thereby, each digit in the nominal value field can be separately highlighted and modified.

If there is subsequently a difference between "measured value" and "nominal value", by pressing one of the buttons "Menu", "Exit", "Back" it is queried whether these changes should be carried over (YES) or not (NO) with the possibility of cancellation ([Figure 7.40](#)). In case of cancellation (red circle), the system remains in the previous state and further modifications can be carried out (e.g. to correct incorrect inputs). If the result of the adjustment is accepted with a "Yes" ([Figure 7.40](#)), SonoDur2 will then query whether the new adjustment should be applied to the current measurement series or if a new series should be started ([Figure 7.41](#)). With a "Yes", the measurement data will be converted with the new adjustment number and the measurement series

will be continued. With a "No", the measurement counter will be set to N = 0 and it is queried whether the data should be stored. If "Yes", the sub-program "Save File", Page 42, section 7.11.1, opens up. Only then a new measurement series will be started.

- b.) "NO" (Figure 7.38): The determined average value is not used and therefore, (3-5) measurement values must now be recorded within the adjustment program (Figure 7.43). Only the average value will be displayed. Subsequently, the nominal value can be entered (Figure 7.44) and reconfirmed.

If no measurement series is available, the adjustment measurement will be directly started, as described under b.).

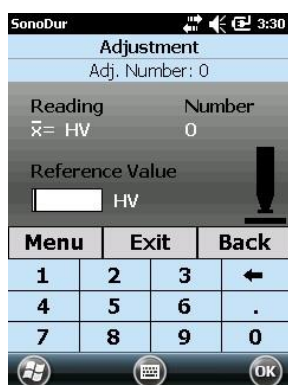


Figure 7.43

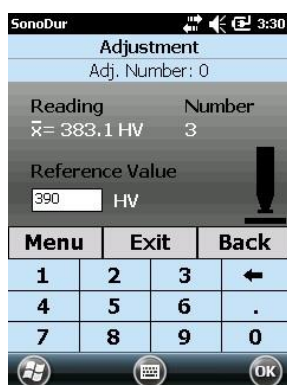


Figure 7.44



Figure 7.45



### Please note:

The proceeding under a.), i.e. recording a measurement series at first, has the advantage that the individual measurements can be analyzed in the run-up via the info button in the measurement menu and hence, potential rogue results can be detected and eliminated. In this way, an "improved" adjustment measurement is possible in the first place, since under b.). This possibility of correction of individual measurements is not provided.

Thus, we recommend the proceeding under a).

## 7.7.2 Adjustment Number Directly

If the adjustment number is already known, it can be directly used by selecting "Set of Adj. Number".



Figure 7.46

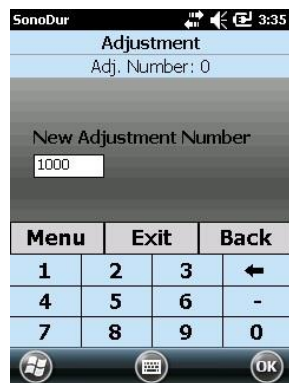


Figure 7.47

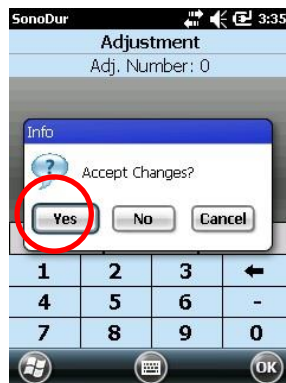


Figure 7.48

The SonoDur2 then asks, if the adjustment number should be used for the actual measurement set, or if a new test series should be started. By answering “No” all actual measurement values will be recalculated with the new adjustment value.

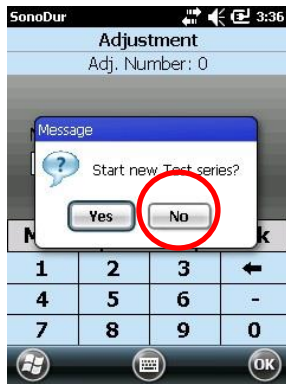


Figure 7.49

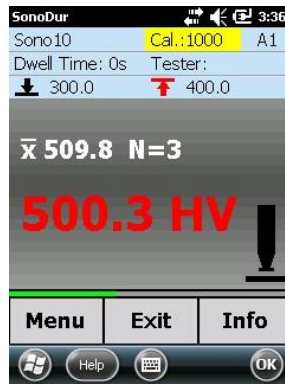


Figure 7.50

By answering “Yes”, the instrument queries if the actual measurement set should be stored or not. If “Yes” the “Store File” menu opens and after storing the measurement set, a new test series will be initialized.

### 7.7.3 Delete Adjustment

By executing via the “**Forward**”-button, the adjustment number will be set back to 0 = low alloy steel, if a adjustment exists (Figure 7.52).

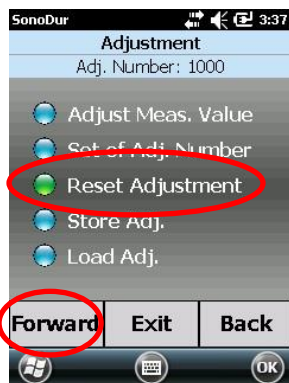


Figure 7.51

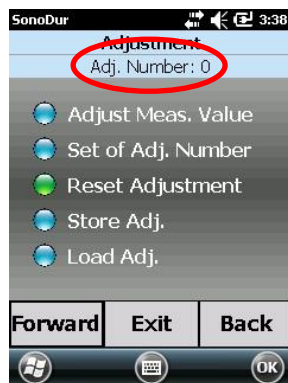


Figure 7.52



#### Please note:

If a different material than low alloy steel (A1) is chosen (for example F5 with its corresponding adjustment number), the adjustment is not deleted but is recessed to the initial value.

#### 7.7.4 Save and Load Adjustment

Save (**Figure 7.53**): The device automatically suggests a name. A new name can now be selected by means of the keyboard. Load (**Figure 7.55**): Calling up of a stored adjustment file in the Folder “SonoDur2\_Calibration”. The standard setting for the directory is “All Folders”.

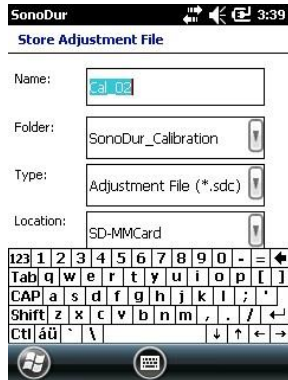


Figure 7.53

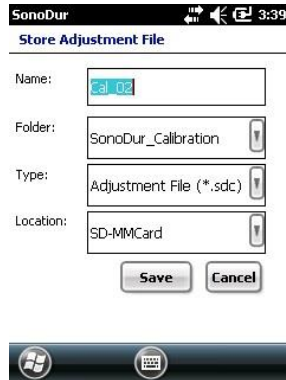


Figure 7.54

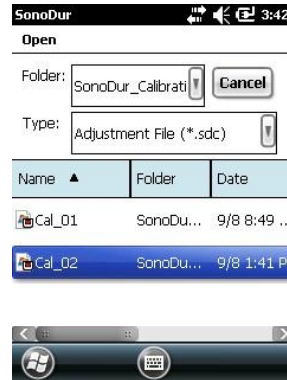


Figure 7.55



Figure 7.56



#### Attention:

If an adjustment files is chosen containing different test force data as the connected probe has programmed for, the message above (**Figure 7.56**) is shown.

Long time practical experience using our stable SonoDur probes shows a good correlation for all probe types using the same adjustment number even for different test loads. Therefore we have one unique CAL value for different test loads using the material tables F2, F3, F4, F5 (EN ISO 18265) or T4, T7, T8, T9 (ASTM E140).

Definitely the adjustment for all test loads is true for the correction of the influence of the young's modulus. This holds as long as no other surface effects (hardness increase, roughness) affects the measurement.

Therefor adjustment data can be used for probes with other test forces as stored in the selected adjustment file. It is the responsibility of the inspector to use these settings or not. If you are not sure, use a probe with the corresponding test load.

The “Save” Button is hidden (**Figure 7.53**) through the virtual keyboard, you have to close the keyboard first to save adjustment data.



## 7.8 Conversions

### 7.8.1 Hardness Scale

Selection can be made by tapping on the available scale (**Figure 7.58**). The conversion standard and selected material will be indicated in the status bar. Standard or material can also be selected by means of the "Back"-button.

### 7.8.2 Standard

Two conversion standards, in accordance with ASTM E140 and EN ISO 18265, are available in its current version (**Figure 7.59**) - Status 2015.



#### Attention:

Please consider the conversion limits. Exceeding the limits of a scale (for example within the HB scale) you will receive the message **out of the HB revaluation** and the measurement values will be shown within the Info-window as deleted (please refer to the representation of the measurement values outside of the conversion limits, [section 7.8.4](#)).

### 7.8.3 Material

Up to program version V1.07 conversions are only stored for steel, from version V1.09 and higher all conversions according EN ISO 18265 are available (**Figure 7.60**). Selecting a differing material as A1 Steel will also automatically select the corresponding CAL factor (deviation of the material properties related to low-alloy steel, refer to chapter [7.7 Adjustment, page 33](#)).



Figure 7.57



Figure 7.58



Figure 7.59



Figure 7.60



#### Please note:

Some conversions are related to a standard, so conversion to HK scale is not possible in EN ISO 18265 (red dot). In that case, you have to select the ASTM140 standard.

### 7.8.4 Representation of Readings beyond Conversion Limits

Conversion tables according EN ISO 18265 and ASTM E140 are defined over different ranges for different material tables. For all SonoDur instruments the Vickers scale (HV) is the reference scale and for every measurement there is always a Vickers value. If there exists no pairs of values in HRC, HB etc. for conversion, a value will be generated using extrapolation algorithm. If this is unsuccessful, the user should switch to another hardness scale or select the Vickers scale. Values which are

generated by extrapolation algorithm are not covered by standards and do have a higher uncertainty. Therefore these values are displayed in red and it is up to the user to decide whether to use these values or not.

- If the converted value is slightly outside the scale limits given in the standards, a value will be calculated using extrapolation algorithm and displayed in red.
- Exceeding the extended conversion limits (extrapolation range)\* an error message „**Outside HB Conversion**“ (if HB scale is selected) will be displayed. These readings are marked as deleted and displayed as --- in the information menu (Figure 7.62). Returning to the measuring menu the latest valid reading will be shown.

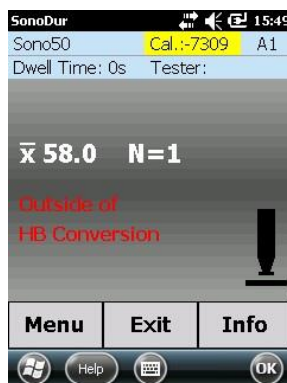


Figure 7.61

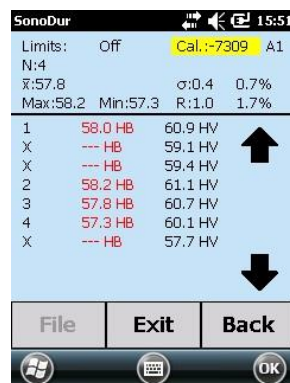


Figure 7.62

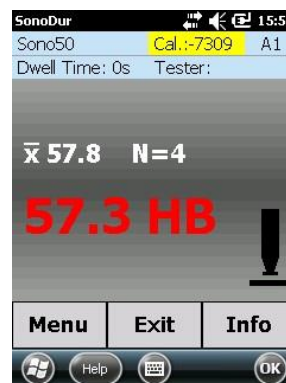


Figure 7.63



### Attention:

Extended conversion ranges (extrapolation ranges)\* are calculated from the correlations given in the EN ISO 18265 (ASTM E140). Due to the fact of higher uncertainty of these values the responsible inspector must decide about the permissibility of the conversions from Vickers hardness into another hardness scale by his own.

## 7.9 Measurement Results

Selection of the presentation of measurement results in the device menu under "Settings".

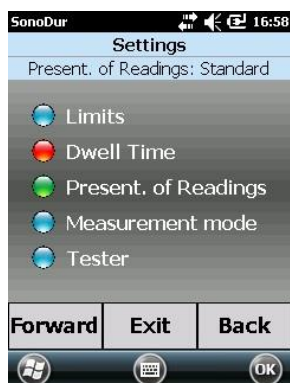


Figure 7.64

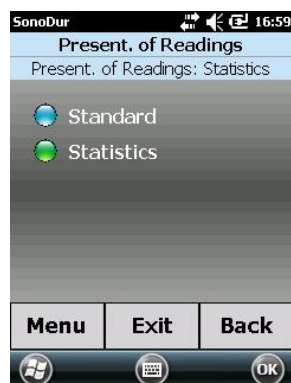


Figure 7.65



Figure 7.66

The factory setting is "Standard" (e.g. [Figure 7.65](#)). Users, who want to view all measurement results, may select "Statistics" ([Figure 7.66](#)). However, the direct access to the submenus will be turned off and the operation is only possible via the lower menu buttons.

## 7.10 Settings

### 7.10.1 Limits (Thresholds)

If no limits (thresholds) have been defined ([Figure 7.68](#)), the maximum tolerance range for the selected hardness scale will be displayed for selection.

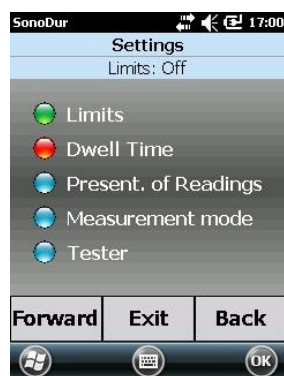


Figure 7.67

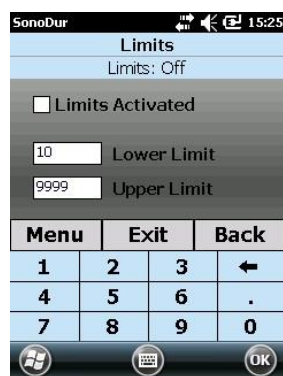


Figure 7.68

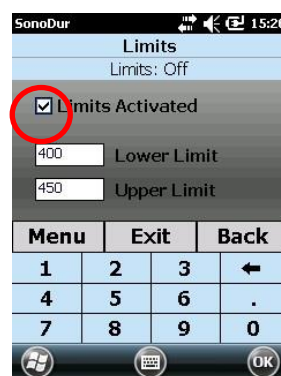


Figure 7.69

The selected tolerance thresholds must be turned on via "thresholds active" (check mark, [Figure 7.69](#)). Tolerance thresholds can be set at any time of measurement in order to optimize the analysis of results.

### 7.10.2 Dwell Time

In accordance with the instructions for motorized measuring probes, the dwell time (penetration time) can be adjusted between 1 and 99 seconds ([Figure 7.72](#)). If the input value exceeds the permitted limits, an error message will be generated which must be confirmed in the display via the "OK"- button. Thereupon, the initial numerical value will be displayed once again, which then can be corrected in the input field. If the penetration time gets changed, a current series of measurement must be completed and a new series must be started ([Figure 7.72](#) and [Figure 7.73](#)).





## Attention:

The **dwell time is set to fixed value 0 seconds** with hand-held measuring probes and can't be changed. Nevertheless please check this setting, otherwise false readings are possible.

Setting of dwell time:

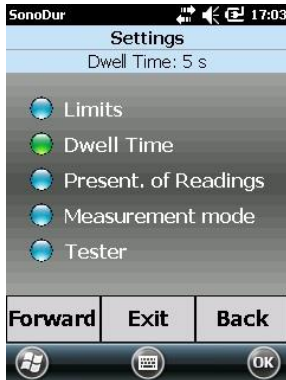


Figure 7.70



Figure 7.71

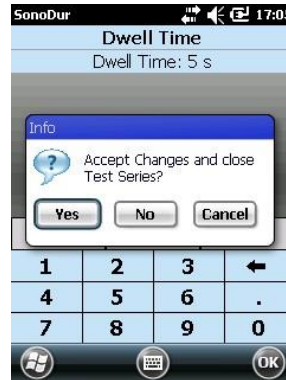


Figure 7.72

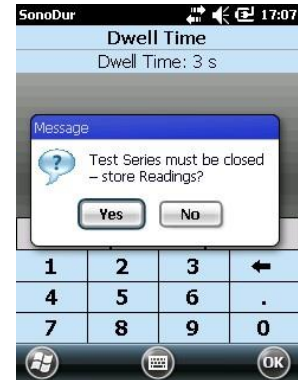


Figure 7.73

### 7.10.3 Measurement Mode

Selecting the operational mode for the motor driven probe ([chapter 7.4.1, Carrying out of Measurement by Means of Motorized Probes](#)) or automatic data storage function ([Figure 7.77](#), available from software version 1.13 and higher). This is particularly beneficial in cases where many measurements have to be taken on the same object on different test positions. The number of desired measurements can be pre-defined (in this case 5) and is displayed in square brackets ([Figure 7.77](#)) in the measurement menu. If the counter N for the number of measurements equals the pre-defined value in the square brackets, the actual measurement series will be stored automatically.

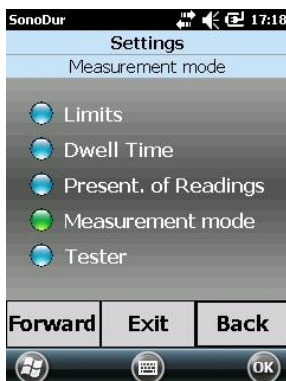


Figure 7.74

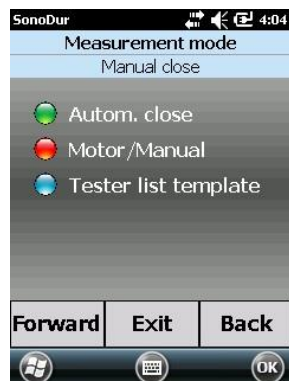


Figure 7.75

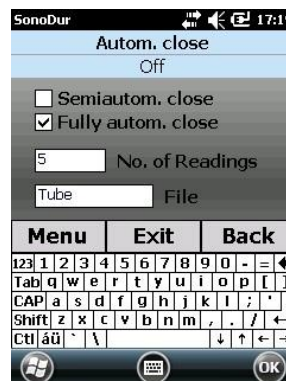


Figure 7.76

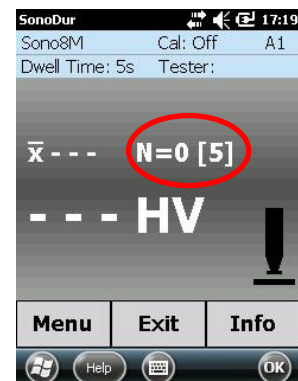


Figure 7.77

After the selection of the **Measurement-mode** and **automatic close**, the dialog for the settings of the automatic save-function will open. The last used file name will be used with indexing (Index increases +1, so that the already saved file will not be overwritten). This name can be changed.

The user can choose between the full- and half-automatic modes. Within the choice of the automatic close-Mode, the current measuring row, after achievement of the number of measuring values, will

be saved under the given file name (here Tube). After 5 other measurements in each case becomes Tube\_01, Tube\_02 etc. saved.

To avoid overwriting of existing files, the file name (if already present) will be extended with an index by +01, see example in the following:

Tube	new Name, 1. Save
Tube_01	2. Save
Tube_02	3. Save
Tube_02_01	4. Save, Name Tube_02 is already listed!
Tube_02_02	5. Save
Tube_02_03	6. Save

Within the choice of half-automatic-closure, the dialog for the storing process is opened, when you reach the preset number of measurements:

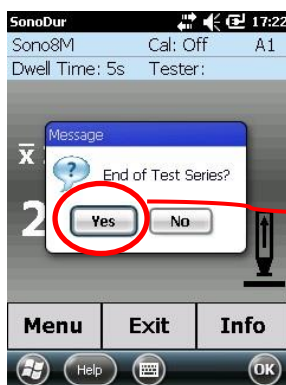


Figure 7.78

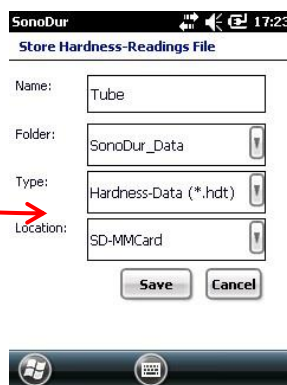


Figure 7.79

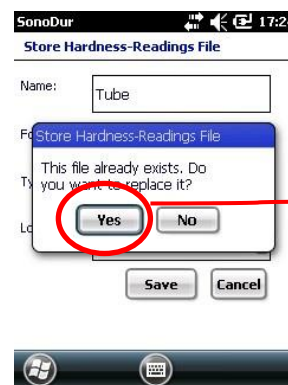


Figure 7.80

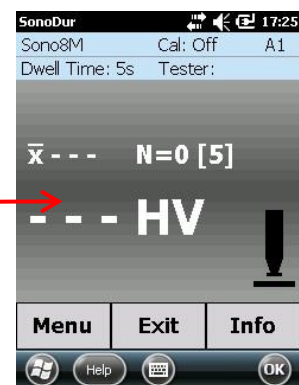


Figure 7.81

If querying “Yes” when being asked „End Test Series” (Figure 7.75), the save file menu will pop up (see chapter 7.11.1). If the file already exists, SonoDur asks if it should be replaced (Figure 7.77). With “Yes”, the file will overwrite the existing one and jump back into the measuring menu. With “No” another name can be chosen.

By confirmation the query “End Test Series” with “No”, the measuring row is continued and the counter N for the measuring value number is increased with every measurement.

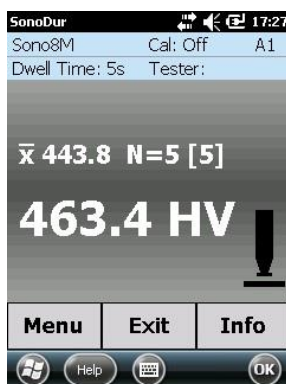


Figure 7.82

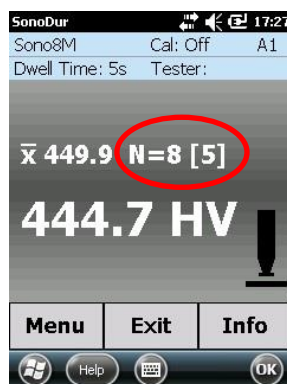


Figure 7.83

#### 7.10.4 Working with Templates

From software version 115 or higher measuring values and tester names can be easily managed using templates. These templates in txt-format are located in the SonoDur\_System folder and can be easily created or modified on a PC.

Creating a new entry for an inspectors name is done as before via the menu **settings/Tester** or clicking on the input field "Tester" in the main menu. A new selection list with already created tester names is arranged left beside the input field. Tester names could be directly selected from the list (see following section).

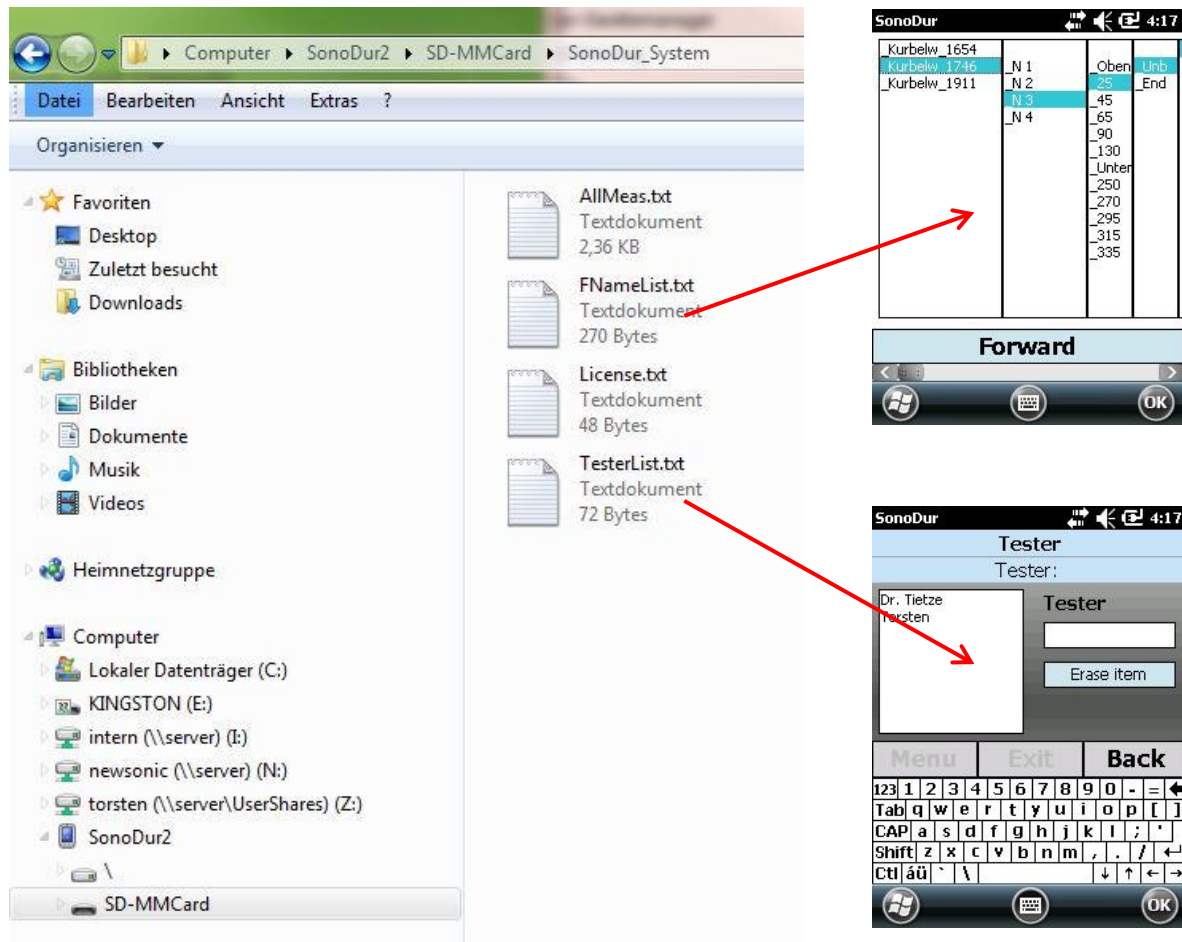


Figure 7.84

Now storage of measuring values due to periodic inspections of known components and test positions is now much easier and faster using templates. The file name of the **data set which has to be stored must not entered via the keyboard but can be created by selecting from the template.** This template (.txt format) must be created first and copied to the SonoDur\_System folder. If this template is available in the SonoDur\_System folder, the user can enable the use of the template by selecting Test list template from the Settings/Measurement mode menu (see [Figure 7.85](#)). After the instrument has been set up to use templates, the selection list (max. 5 columns possible) will pop up if the **store file** dialog is selected or the **automatic data storage function** ([Figure 7.77](#)).

This saves the hassle of typing the name for the data file and makes it much easier during periodic or known inspection positions to create complex names fast and without any errors.

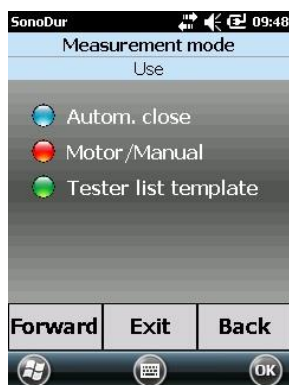


Figure 7.85

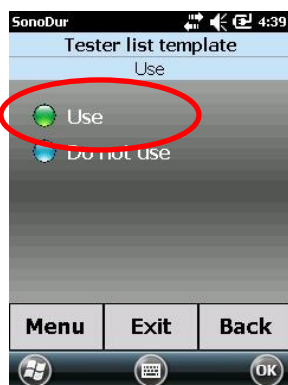


Figure7.86

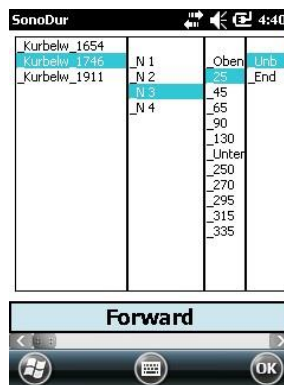


Figure7.87

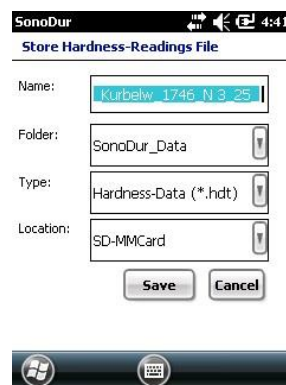


Figure7.88

Example of a template (FNameList.txt), each column is separated with an empty row, in this case 4 columns.

```
Kurbelw_1654
Kurbelw_1746
Kurbelw_1911

_N 1
_N 2
_N 3
_N 4

_Oben
_25
_45
_65
_90
_130
_Unten
_250
_270
_295
_315
_335

_Unb
_End
```

Figure 7.89

### 7.10.5 Tester

From software version 1.03 SonaDur2 offers the ability to personalize the results by entering the tester. Change from the instrument menu over to the setting menu and select "Tester". Using the keyboard you can enter the name of the inspector (see Figure 7.91). Direct access by tapping the soft-key "Tester" in the measuring menu is also possible. The name of the tester will appear in the log file as well.

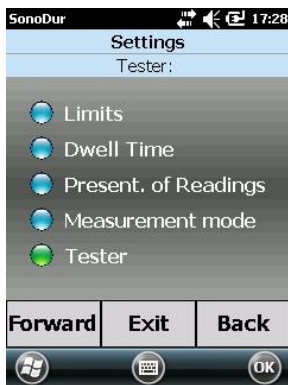


Figure 7.90



Figure 7.91



Figure 7.92

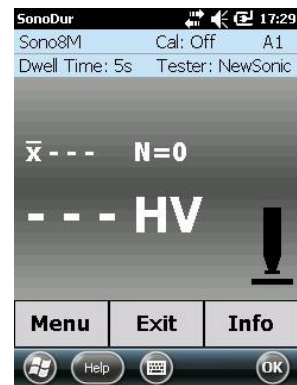


Figure 7.93

## 7.11 SonoDur2 Data Handling

SonoDur2 provides the opportunity to store and access measurement data and transfer to external computers.

### 7.11.1 Save Files

Measurement data can be stored under an individual name and reactivated. Upon completion of the measurement series via the "Exit"-button, SonoDur2 queries whether the measurement data should be stored. This also applies to the event, that the process parameters should be changed (dwell time, new adjustment). If the question is answered with "Yes", the device menu for the saving of measurement data opens up (Figure 7.95). SonoDur2 suggests a file name and increments each with +1 if a new measurement series has been finished.



Figure 7.94



Figure 7.95

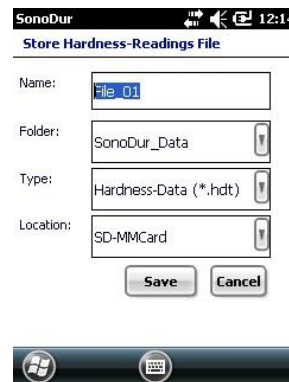


Figure 7.96



### Please note:

The virtual keyboard must be closed first get access to the "SAVE" Button.

The domain "SonoDur2\_Dat" is predefined as data folder. This can be modified in the PDA menu. All data is stored on the installed micro SD-Card, which can be removed and externally read from a card reader connected to a PC. Further details are provided in the next Section "Open File", section 7.11.2.



### 7.11.2 Open File

If you select "Open File" in the device menu, any saved measurement series can be indicated again. The accessible program area is limited to the information area, i.e., the data can only be viewed (see [Figure 7.97](#) to [Figure 7.100](#)).



Figure 7.97

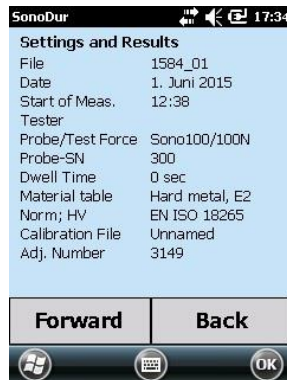


Figure 7.98

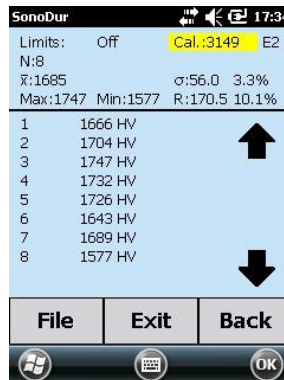


Figure 7.99



Figure 7.100

It is not possible to make any further changes (measuring value correction) and tapping on a measurement line is responded with an error message. This can be easily cancelled by clicking the "OK"-button.



#### Please note:

When leaving the INFO menu via the EXIT button ([Figure 7.99](#)), the stored measurement settings of this file can be carried over in the transition to the measurement menu, if the query becomes confirmed with "Yes" ([Figure 7.100](#)) and the currently connected probe features the same test force than the probe under which the measurements have been stored. This enables the direct continuation of measurement series with the familiar settings.

### 7.11.3 Data Transfer and Interfaces

In order to be able to transfer data via USB cable, Bluetooth or WLAN, the installation software for the SonoDur2 device must be installed.

Detailed descriptions of computer systems, based on WIN XP and WIN 7 can be found in section 10.6, "Installing Interfaces and Drivers".



#### Please note:

It is generally recommended to back up important adjustment data into higher-level computer systems in order to avoid data loss in case the device is defective.

- The saved measurement data is stored in two file formats, namely text files (.txt), and source files (.hdt). After data transfer completion the text files can be further processed in any desired form.
- However, the original data is immutable and should therefore also be stored in higher-level computer systems.

- These original measurement data is important for the verification of data security and traceability of test results for potential audits.

#### 7.11.4 USB Cable

Connect the SonoDur2 device to the PC via USB cable and turn on the device. The driver software will now be automatically installed (this may take a while) on your PC and the appropriate communication program starts automatically.

**WIN XP:** The system folder "Windows Mobile" can now be opened via "My Computer" and like with any other external storage device, data can be read or folders may be created and deleted.

**WIN 7:** Windows Mobile will be automatically started and the SonoDur2 device will be configured. The "Windows Mobile Device Center" will open up and the setup of the SonoDur2 device is provided however, this is not necessarily required and therefore can be interrupted (please also see section 10.6.2, "Connecting SonoDur2 to your Computer"). Only the internal memory of the SonoDur2 device can be opened under "File Management" and the data processing can now take place with any external storage device.

All stored data can now be completely transferred from the SonoDur2 device to the PC in one go and the text files, for instance, can be converted into Excel files. For this purpose, Excel gets started in order to import the desired text document.

#### 7.11.5 Bluetooth

Please see Section "Bluetooth Setup", page 45 in order to install the Bluetooth interface.

Activate the Bluetooth function on the SonoDur2 screen (SonoDur2 program must be closed for this purpose) by tapping on the appropriate symbol on the bottom right hand side. The Bluetooth menu will be started and Bluetooth can be turned by tapping on the tick and make it recognizable to other devices.

Select the relevant file for data transmission and select the "Transfer File" menu function on the bottom right hand corner of the screen. At this point, the Bluetooth interface of the PC will be searched and released for data transfer by tapping on the SonoDur2 screen – please also see section 10.6.4, page 60.

The data transfer must be approved with "Yes" on the PC. The result of the data transfer will then be displayed in the so-called "Inbox" of the USB device and can be stored on a PC for further processing via Excel, Word, etc.



#### **Please note:**

- The PC must be equipped with a Bluetooth interface or featured with a USB Bluetooth adapter (Please see section 11.1, "Scope of Delivery and Accessories").



- In order to ensure faultless installation, please follow the instructions on the individual device menus.
- It is only possible to transfer individual files. In order to perform a complete transfer of records, it is required to connect a USB cable.
- Data cannot be collected from the SonoDur2 device by means of the PC, i.e. the whole data processing procedure must take place inside the device itself, if no USB interface is used.
- In order to avoid unnecessary energy consumption, it is recommended to deactivate the Bluetooth interface during normal test operation.

#### 7.11.6 WLAN

Please contact your network administrator or your local service provider in terms of WLAN connections.

#### 7.11.7 Data Card Operation

The SonoDur2 saves all measurement and adjustment data on an exchangeable micro SD card. The advantage is that in the (unlikely) event of a device defect, measurement and adjustment data will remain safe with very high probability and can be easily transferred from the SD card to a PC. In this event, please contact our customer service.

## 8 Functional Monitoring by the Operator

The UCI tester is a precision device and should therefore guarantee flawless operation over a long period of time, if appropriately and carefully used. Nevertheless, it is advisable to perform the following system checks:

- Check the measurement accuracy and reproducibility with hardness reference blocks (we recommend MPA-certified hardness reference blocks). It is described in **DIN 50159**. Here we deviate from the mandatory use of a specific size of block but recommend in any case to couple any reference plate to a solid plane steel block using NewSonic special coupling fluid for instance. At least 3 measurements should be performed (spread over the entire area of the hardness reference block). The permissible deviation from the mean value to the nominal value of the block must not exceed 5 % at test forces between HV 5 and HV 10 or depending on the range, 7 % at HV 1. In the low load range from HV 0.1 until HV 0.8, the maximum uncertainty of measurement amounts up to 9%. (see section “[Measuring Method](#)“, page 7)
- Check the penetration diamond under the microscope for damages.

If you notice any damage to the probe and / or tester, you should immediately put the device out of operation and send it to our service department for inspection. This also applies to the case if measurement deviations are too high.



### Please note:

We recommend to have the system reviewed on an annual basis by our service department or by any other authorized NewSonic sales and service partners.

### 8.1 Software Version

The version of the SonoDur2 device software can be queried via the soft keys [Help -> About](#):

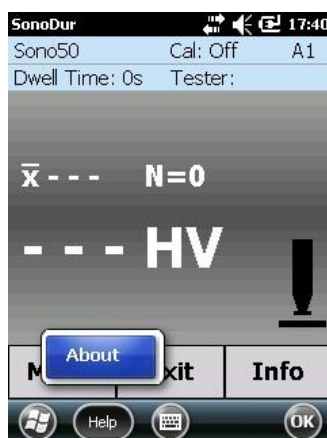


Figure 8.1



Figure 8.2

## 8.2 Error Messages

Error Message	Corrective Action
Main battery is very weak, power indicator LED is red	Charge SonoDur2
Connection is interrupted, shut-down of Program.	Probe lost connection to instrument during operation. Check cable and connectors. See <a href="#">Section 6.3 “Removing Probe Connector during Operation”</a>
COM 6: is not the virtual USB-interface, or the Probe was not found under this Interface. Start Program without Probe?	Probe is not connected during power on. Check correct connections to probe. See <a href="#">section 6 “Connect and Disconnect Probe”</a> . SonoDur is in simulation mode.
Unknown USB device	SonoDur2 is not recognized as USB device when connected to a PC. Check cable and firewall settings (see <a href="#">section 10.6.2</a> )
Conversion into MPa solely for test loads of equal to or higher than 100N (10kgf). Allow anyhow?	Scale could only be used with a 100N (10kgf) probe. Select correct probe (force), or allow conversion in Tensile Strength for test loads $\leq 100\text{N}$ (10kgf). In this case the conversion is not covered by standards and do have a higher uncertainty. Therefore the user is to decide whether to use these values or not.
Dwell Time must be between 0 and 99 Seconds	Chose dwell time between 0 and 99 sec.
Error in handling the probe, contact time too long.	Lift probe and start a new measurement. Check intender / end of oscillation rod / bore of protection sleeve for damages / contaminations. If necessary, clean surfaces with a dry and soft cloth.
Adjustment does not fit to current Test Force Cal=xxxx Accept Changes?	Adjustment was done with another test load (probe). It is the responsibility of the inspector to use these settings or not. (see chapter <a href="#">7.7 Adjustment</a> ). If you are not sure, use a probe with the corresponding test load.
Out of xx Scale	The measurement value is outside of the defined conversion limits. Please choose another scale /standard or Material-Table)
Error in probe, shift of zero frequency out of tolerance. Reference value: xxx Hz Actual value: yyy Hz. Program is terminated.	Too large shift of oscillation frequency (mostly because of contamination, drop or hard shock), program will terminate. If the problem could not be solved due to cleaning, please send probe back for check and recalibration.

Table 8-1

## 8.3 Troubleshooting

Should the unlikely event occur that the test device cannot be operated, proceed with the following steps:

### 8.3.1 Operating the On/Off Switch

Keep the On/Off switch pressed down, until the screen goes black (approximately 8 seconds). Then turn on the device again.

## 9 Care and Maintenance

### 9.1 Test Device, Probe and Cable

From time to time, wipe the tester, probe and cable with a damp, but not moist cloth, e.g. microfiber cloth. Under no circumstances, chemicals or cleaning agents should be used.

### 9.2 Screen

Do not use any sharp objects, chemicals or detergents for cleaning, since the protective foil could be destroyed. Please use moist lens cleaning cloths instead. A protective film is attached in order to protect the touch-sensitive touch screen. If it contains severe stains or scratches, the protective film can be replaced by a new one.

### 9.3 Batteries

The batteries are nearly maintenance-free, if they are used in the specific environmental area. However, you should observe the following instructions:

- Prior to initial commissioning and after it has been stored for more than 2 months, the battery needs to be fully charged.
- The device is featured with an intelligent charging system to ensure that there is no danger of overcharging, even if it has been connected for a longer period of time. However, we are recommending that you disconnect the unit from the mains supply upon after completion of charging.



### **Safety Information:**

Batteries must never be exposed to temperatures exceeding the specified operating or storage temperatures!

The plug-in power supply may only be operated in dry areas!

## 10 System

The test device is an energy-efficient mini-computer with a Microsoft Mobile operating system. This enables adjustments of many much energy and display settings. Upon delivery, the SonoDur2 is preset to optimal default values, so that you usually no longer have to worry about these settings. The following guidelines are intended for custom-specific settings.

### 10.1 System Settings

You reach the system settings over the Windows symbol in the lower left image border. Here you also find the File-explorer with which you can look at files, copy or shift. With the symbol Settings you reach the next menu level and from there you can change the button system in the system level in which you can carry out all important device settings.



Figure 10.1

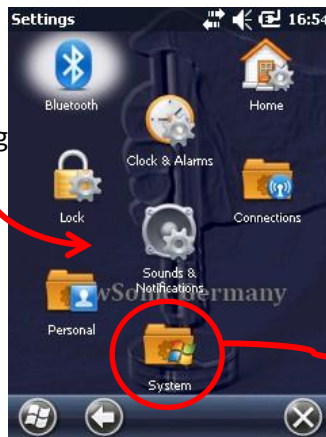


Figure 10.2



Figure 10.3



Figure 10.4

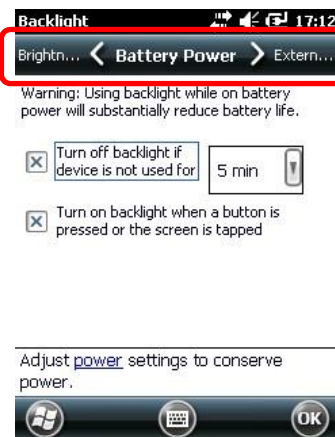


Figure 10.5

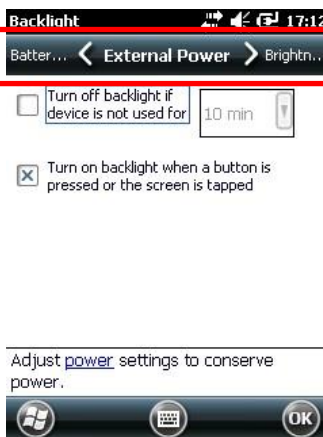


Figure 10.6

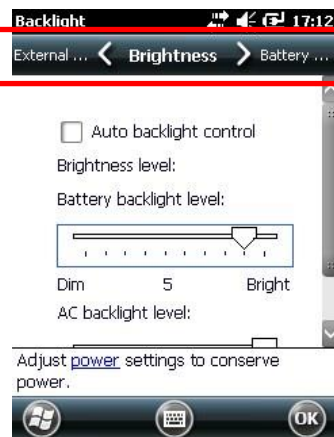


Figure 10.7

The settings for the behavior for battery and mains operation and backlight control could be select via the scroll bar below the status bar in the upper display region.



## Note:

The adjustment „*Turn off backlight if device is not used for*“ within the menu **Battery Power** does not affect the brightness of the background, but the automatic shutdown function, after the adjusted time!

We recommend that you don't undertake any changes.

### 10.3 Automatic Shutdown

You can change the behavior for automatic switch off via the menu “Backlight”, see preceding tips.

### 10.4 Adjust Touch Screen

In case the operation of the touch-sensitive screen fails, you should adjust the touch screen.

You find this function by touch lightly the Screen of symbol in the system menu. You reach this function in lower half of the system menu by pushing (wipe) the screen upwards. Press the button Align Screen and follow with the touch pen the shown crossing. Close the adjustment with OK.

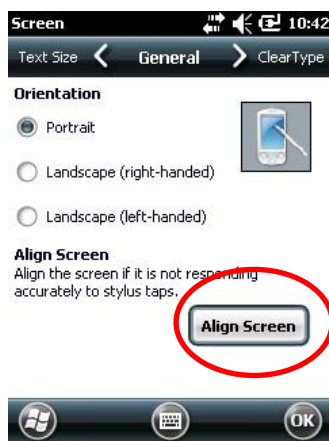


Figure 10.8

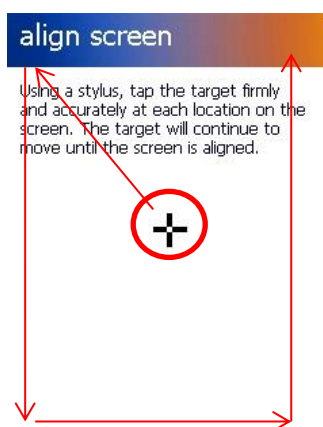


Figure 10.9

### 10.5 Virtual Keyboard

The virtual keyboard can be activated by pressing the button at the lower bottom of the screen (if entries are necessary). The appearance can be modified by selection via the arrow symbol.



## 10.6 Installing Interfaces and Drivers



### Attention:

You should have basic knowledge of computers and working with the Microsoft file explorer. Improper use can cause data loss and/or damage to system files, resulting in a non-functional device!

The SonoDur2 device features 3 data transmission interfaces, namely USB, Bluetooth and WLAN. In the following, the installation for operating systems on the basis of Windows XP and WIN 7 will be explained. During the installations, please follow the setup instructions displayed on your screen. In case you are unsure or use other systems, please contact your network administrator.

When using the Bluetooth and WLAN radio links, please observe the following safety guidelines:

- Keep a distance of at least 30 cm to any medical equipment or pacemakers to avoid interferences with these devices and thus, cause a potential danger to those individuals!
- Hearing aids can produce a disagreeable buzzing or humming.
- Please turn off your wireless components as a precautionary measure before boarding any airplane or when you are driving a car.
- Please also turn off your wireless components, if you are in the vicinity of inflammable gases or in explosion-hazardous environments.

### 10.6.1 Preparedness

In order to exchange data with a PC, you must have the software **ActiveSync** (Windows XP) or **Windows Mobile Device Center** (Vista, Windows 7) installed on your PC. The corresponding program is already installed on the SonoDur2 device.

For computers with Windows7 and higher the Microsoft Mobile Device Center is normally already installed. If your computer uses Windows7, you can proceed with section 10.6.2.

Press -> **Start -> All Programs** and look for **Microsoft ActiveSync** or **Microsoft Mobile Device Center**. If none of these programs exist, you have to install it.

In order to find out which operating system you are using, press -> **Start, ->right mouse click on My Computer** and then click on -> **Properties**. You will find the appropriate driver for your operating system on the SonoDur2 system CD. Double-click on the appropriate installation file and follow the instructions.

### 10.6.2 Connecting SonoDur2 to your Computer

The following description is created for computers with Win7, but basically true for other operating systems.

Connect the SonoDur2 device to the PC using the USB data cable (turn on the power if necessary). Wait until the Windows Mobile Device Center automatically starts (this may take a few seconds). The green check mark indicates the active USB connection. Select "Connect without setting up your device".



#### Attention:

Do not allow the computer to synchronize with the SonoDur2 instrument! Please check your **firewall settings** and allow access for Microsoft Mobile Device Center or ActiveSync!



Figure 10.10

Move the mouse to "File Management", it opens a submenu. Please click on "browse contents of your device". This opens the file manager and the SonoDur2 device is now shown as a mobile device in the file explorer and you can access the measurement and adjustment data in the SonoDur2 directory (see Figure 10.12).

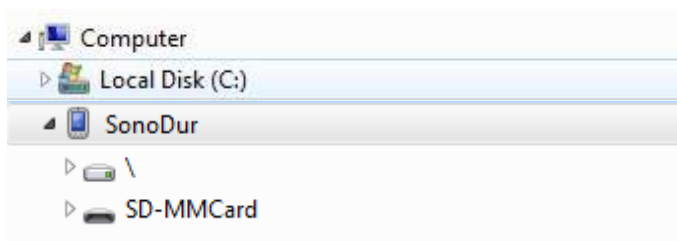


Figure 10.11

... \SonoDur\SD-MMCard\...

(SonoDur Version 1.01 and higher, storage path SD-MMCard)

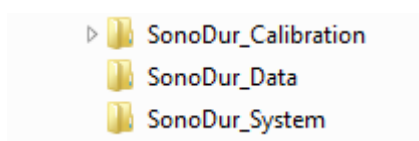


Figure 10.12

If you have chosen the main memory as the location for your measurement and calibration files, the storage path is ... \SonoDur2\MyDocuments\...

### 10.6.3 Bluetooth Setup

The SonoDur2 device is featured with an integrated Bluetooth module and is able to wirelessly exchange data with (almost all) computers that are featured with Bluetooth functionality. If your computer does not have Bluetooth functionality, you can simply expand your computer by means of the USB stick Bluetooth SONO-Blue, if your PC is featured with Windows XP operating system or higher (Vista, Windows 7).



The following configuration has only to be done once for the initial setup of the new connection!

Simply plug the USB Bluetooth module into an available USB port. Windows normally automatically recognizes the Bluetooth dongle and installs the required drivers. Alternatively the driver could be installed from the SonoDur2 system CD. After the installation procedure has been successfully completed, the symbol for Bluetooth devices appears on the bottom right corner of the taskbar:



Click on the symbol and check the connection adjustments on site of the PC:

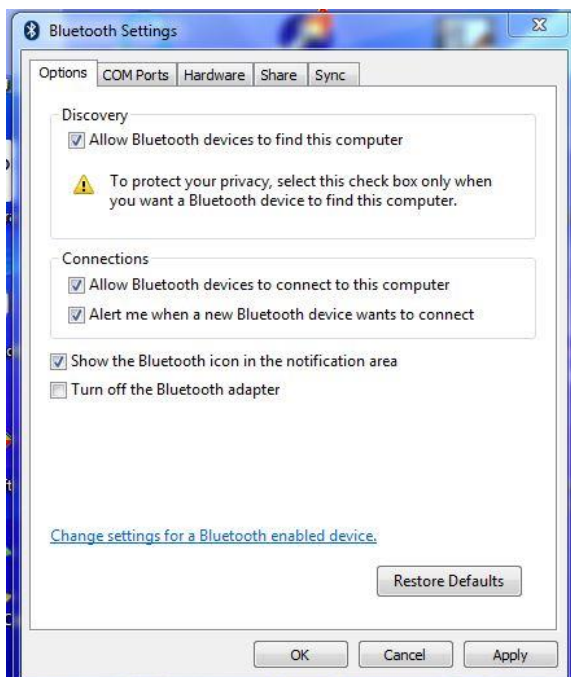


Figure 10.13

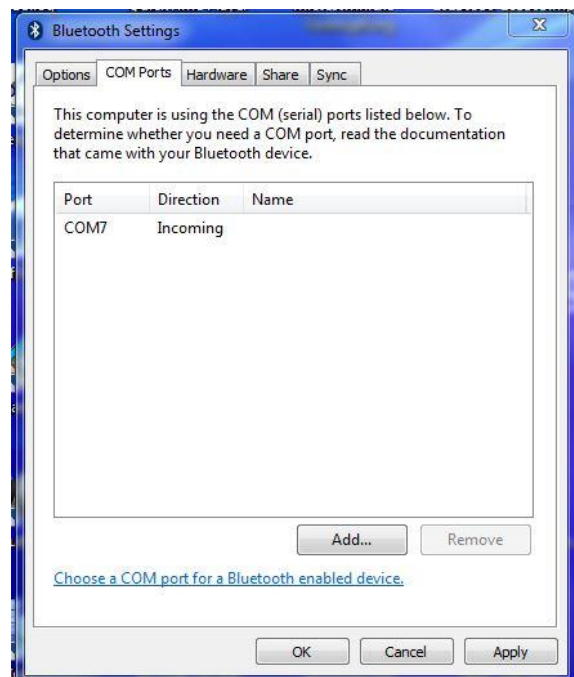


Figure 10.14

Switch on the SonoDur2 and change to **Wireless Manager** by selecting the status band in the upper region of the display. Turn on the Bluetooth function, as shown below:

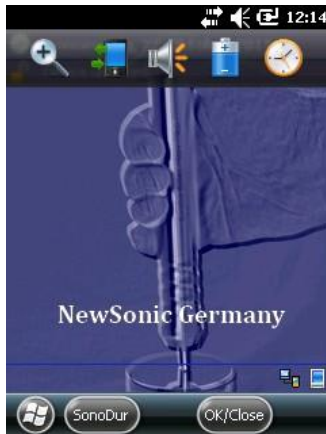


Figure 10.15



Figure 10.16



Figure 10.17

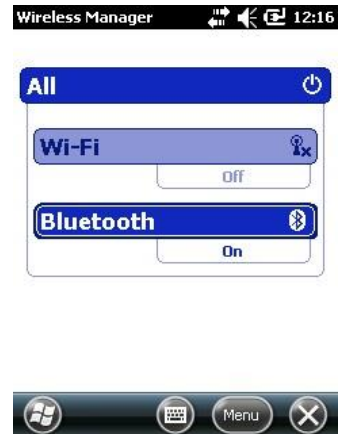


Figure 10.18

In order to get a bluetooth connection with your PC, press -> Menu and -> bluetooth settings. Make the device visible or others and check the interface settings of the COM Ports (Standard COM9):

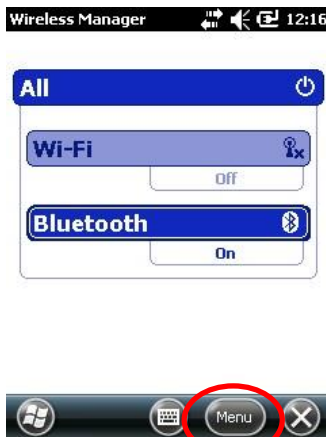


Figure 10.19



Figure 10.20

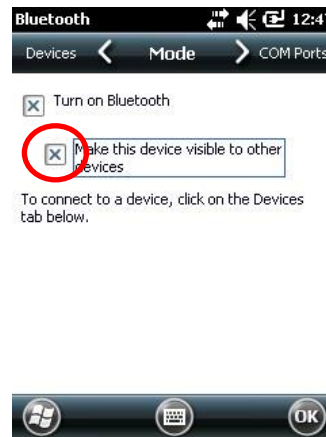


Figure 10.21



Figure 10.22

Search for bluetooth devices (here Torsten-PC) and use, if needed, a password, then press next. Now a new window is shown on your PC and you will ask for a password, please enter the same as on the SonoDur.



Figure 10.23

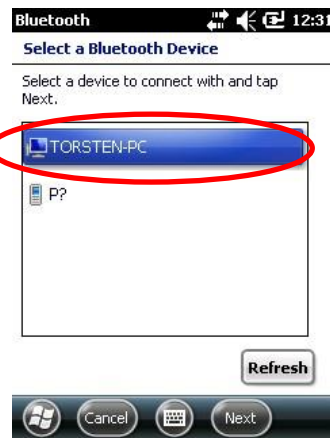


Figure 10.24

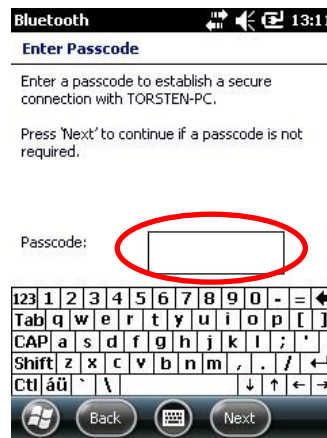


Figure 10.25



Figure 10.26

The Bluetooth connection has been successfully installed!



### Attention:

If your computer is protected by a firewall you must allow data transfer via Bluetooth connection !

#### 10.6.4 Transfer Data to the Computer

Then, keep your finger or pen pressed down on the file to be transferred (or chose “Menu in the right bottom corner) until another menu opens up. Select “Beam File”. After a few seconds (searching), the file can be sent to the PC (see [Figure 10.27](#) through [Figure 10.31](#)):

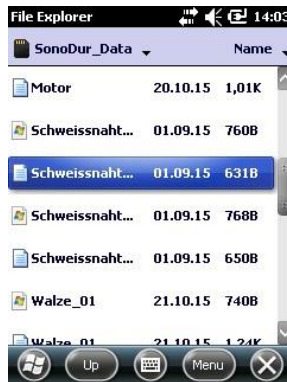


Figure 10.27



Figure 10.28



Figure 10.29

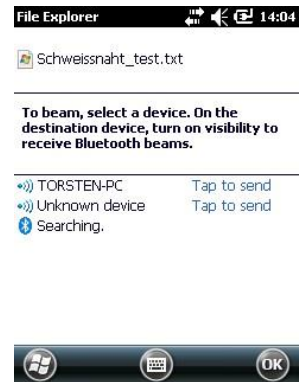


Figure 10.30

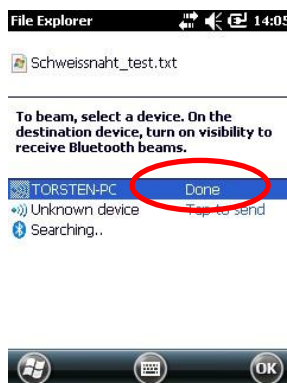


Figure 10.31

The PC will display a message after the file transfer and ask for the download folder to open.



Figure 10.32



**Please note:**

The Win Mobile Explorer is only able to transfer individual files!

#### 10.6.5 WLAN

For configuration details, please contact your network administrator or local support center.



## 11 Appendix

### 11.1 Scope of Delivery and Accessories

#### 11.1.1 Standard parts and packages

Part-number	Description
<b>12004</b>	<b>Instrument Package</b> <b>SonoDur2, Hardness Tester with Data Logger and Data Export, Data Transfer to PC (USB, WLAN or Bluetooth resp.)</b> including: <b>SONO2-NG/USB</b> , Power Source + USB-Cable (Loading/Data) <b>SONO2-HM</b> , ca. 1,5 m Probe Connection Cable <b>SONO2-TK-1</b> , Transportation Case <b>SONO-CD</b> , Product-USB-Stick incl. Operating Manual <b>SONO2-Protect</b> , Protection Foil for Touchscreen Manufacturing certificate <b>Attention:</b> <i>Probes and Hardness blocks to be ordered separately</i>

<b>11006</b>	<b>Package price</b> <b>SonoDur-R, Hardness Tester "Rack" for automatic online Hardness Testing in Production lines, WIN CE Operating System</b>  Including: Mounted Table Housing 19" with Handles Connectors for Probe, Controls, 24V-Power Unit, USB-Client (PC) <b>SONO-RM</b> , 3,0 m Probe Connection cable <b>SONO-NG-24V</b> Powersupply 115VAC-230VAC/24VDC for SonoDur-R <b>SONO2-Stylus</b> , Stylus-Pin <b>SONO-CD</b> , Product-USB-Stick incl. Operating Manual <b>Attention:</b> Probes and Hardness blocks to be ordered separately
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#### Necessary additional information on each order

	<b>Instrument language (operating system is always in English)</b>
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#### Handheld Probes

<b>11101</b>	<b>SONO-10H</b> Handheld Probe 10N (1 kgf), Standard Version
<b>11102</b>	<b>SONO-50H</b> Handheld Probe 49N (5 kgf), Standard Version
<b>11103</b>	<b>SONO-100 H</b> Handheld Probe 98N (10 kgf), Standard Version
<b>11104</b>	<b>SONO-10H-L</b> Handheld Probe 10N (1 kgf), Long rod Version
<b>11105</b>	<b>SONO-50H-L</b> Handheld Probe 49N (5 kgf), Long rod Version
<b>11110</b>	<b>SONO-100H-L</b> Handheld Probe 98N (10kgf), Long rod Version, Special edition
<b>11111</b>	<b>SONO-50H.17</b> Handheld Probe 49N (5 kgf), Special Version with thin Oscillationrod
<b>11112</b>	<b>SONO-10H.17</b> Handheld Probe 10N (1 kgf), Special Version with thin Oscillationrod
<b>11113</b>	<b>SONO-10HL.17</b> Handheld Probe 10N (1 kgf), Long rod Version with thin Oscillationrod
<b>11114</b>	<b>SONO-50HL.17</b> Handheld Probe 49N (5 kgf), Long rod Version with thin Oscillationrod
<b>11115</b>	<b>SONO-30H</b> Handheld Probe 30N (3 kgf), Standard Version
<b>11116</b>	<b>SONO-30HL</b> Handheld Probe 30N (3 kgf), Long rod Version



### Motor Probes

<b>11106</b>	<b>SONO-1M</b> Motor Probe 1N (0,1 kgf) with attachment sleeve
<b>11107</b>	<b>SONO-3M</b> Motor Probe 3N (0,3 kgf) with attachment sleeve
<b>11108</b>	<b>SONO-8M</b> Motor Probe 8,6N (0,9 kgf) with attachment sleeve

### Recommended Standard Packages (Instrument+Probe)

<b>12008</b>	<b>SONO2-1M</b> SonoDur2 + SONO-1M Motor Probe 1N (0,1 kgf)
<b>12014</b>	<b>SONO2-3M</b> SonoDur2 + SONO-3M Motor Probe 3N (0,3 kgf)
<b>12007</b>	<b>SONO2-8M</b> SonoDur2 + SONO-8M Motor Probe 8,6N (0,9 kgf)
<b>12009</b>	<b>SONO2-10 H</b> SonoDur2 + SONO-10H Handheld Probe 10N (1 kgf)
<b>12011</b>	<b>SONO2-50 H</b> SonoDur2 + SONO-50H Handheld Probe 49N (5 kgf)
<b>12013</b>	<b>SONO2-100 H</b> SonoDur2 + SONO-100H Handheld Probe 98N (10 kgf)
<b>12015</b>	<b>SONO2-10H-L</b> SonoDur2 + SONO-10H-L Handheld Probe 10N (1 kgf) Long rod Version
<b>12016</b>	<b>SONO2-50H-L</b> SonoDur2 + SONO-50H-L Handheld Probe 49N (5 kgf) Long rod Version
<b>12017</b>	<b>SONO2-100H-L</b> SonoDur2 + SONO-100H-L Handheld Probe 98N (10 kgf) Long rod Version
<b>12018</b>	<b>SONO2-50H.17</b> SonoDur2 + SONO-50H.17 Handheld Probe 49N (5 kgf)
<b>12019</b>	<b>SONO2-10H.17</b> SonoDur2 + SONO-10H.17 Handheld Probe 10N (1 kgf)
<b>12020</b>	<b>SONO2-10HL.17</b> SonoDur2 + SONO-10HL.17 Handheld Probe 10N (1 kgf)
<b>12021</b>	<b>SONO2-50HL.17</b> SonoDur2 + SONO-50HL.17 Handheld Probe 49N (5 kgf)
<b>12022</b>	<b>SONO2-3H</b> SonoDur2 + SONO-3H Handheld Probe 30N (3 kgf)
<b>12023</b>	<b>SONO2-3HL</b> SonoDur2 + SONO-3HL Handheld Probe 30N (3 kgf)

### Recommended accessories SonoDur2/SonoDur-R

<b>11220</b>	<b>SONO-PS-1</b> Precision Test Stand for handheld probes
<b>11221</b>	<b>SONO-PS-2</b> Precision Test Stand for motor probes
<b>11206</b>	<b>SONO-PM-1</b> Prism support for concave surface shape approx. 100 to 350 mm for Motor Probes
<b>11209</b>	<b>SONO-PM-4</b> Prism support set for motor probes
<b>11223</b>	<b>SONO-SF-2</b> Universal probe foot for Handheld probes (Prism, flat) from Ø 50mm onwards
<b>11210</b>	<b>SONO-ZG-F</b> Special Coupling Fluid, to suppress resonances, 100 ccm
<b>11200</b>	<b>SONO-Doc</b> Auxiliary-SW with automatic documentation of results

### Recommended accessories and spare parts SonoDur-R

<b>11305</b>	<b>SONO-RM</b> Connection cable 3,0 m for handheld and motorprobes (SonoDur-R)
<b>11203</b>	<b>SONO-RM-E05</b> Connection cable 5,0 m for handheld and motor probes (SonoDur-R)
<b>11204</b>	<b>SONO-RM-E10</b> Probe cable elongation to 10 m, for handheld- and motorprobes (SonoDur-R)
<b>11306</b>	<b>SONO-24V</b> 3,0 m Power Cord, M12 a-Coded, one end open!
<b>11307</b>	<b>SONO-NG-24V</b> Powersupply 115VAC-230VAC/24VDC for SonoDur-R
<b>11315</b>	<b>SONO-R-Stylus</b> Stylus-Pen, handmade, special tip

### Recommended accessories and spare parts SonoDur2

<b>12301</b>	<b>SONO2-HM</b> Connection cable 1,5 m for handheld and motorprobes (SonoDur2)
<b>11304</b>	<b>SONO-NG</b> Power Supply 5V USB (SonoDur)

<b>12303</b>	<b>SONO2-NG/USB</b> USB-Cable for Power Supply SONO-NG (loading/data transfer)
<b>12312</b>	<b>SONO2-AKKU</b> Li-Ion, 3.7V, 2600 mAH Power-Pack for SonoDur2
<b>11302</b>	<b>SONO-CD</b> Product-USB-Stick incl. Operating Manual, drivers, tools, product photos etc.
<b>12309</b>	<b>SONO2-TK-1</b> Transportation Case for SonoDur and accessories
<b>12310</b>	<b>SONO2-Protect</b> Protection Foils for Touchscreen
<b>12311</b>	<b>SONO2-Stylus</b> Stylus-Pen
<b>12003</b>	<b>SonoDur2</b> Hardness tester SonoDur2 Instrument with Data Logger
<b>11208</b>	<b>SONO-Blue</b> Bluetooth USB-Connector for PC

### Hardness Blocks

<b>1140807</b>	<b>SONO-Y900HVy</b> Round Hardness Blocks, 900±15 HV30, HV1; Ø64x15 mm, Factory Certificate
<b>1140802</b>	<b>SONO-Y800HVy</b> Round Hardness Blocks, 800±15 HV30, HV1; Ø64x15 mm, Factory Certificate
<b>1140801</b>	<b>SONO-Y700HVy</b> Round Hardness Blocks, 700±15 HV30, HV1; Ø64x15 mm, Factory Certificate
<b>1140808</b>	<b>SONO-Y600HVy</b> Round Hardness Blocks, 600±15 HV10, HV1; Ø64x15 mm, Factory Certificate
<b>1140809</b>	<b>SONO-Y500HVy</b> Round Hardness Blocks, 500±15 HV10, HV1; Ø64x15 mm, Factory Certificate
<b>1140803</b>	<b>SONO-Y400HVy</b> Round Hardness Blocks, 400±15 HV10, HV1; Ø64x15 mm, Factory Certificate
<b>1140804</b>	<b>SONO-Y300HVy</b> Round Hardness Blocks, 300±15 HV10, HV1; Ø64x15 mm, Factory Certificate
<b>1140805</b>	<b>SONO-Y200HVy</b> Round Hardness Blocks, 200±15 HV10, HV1; Ø64x15 mm, Factory Certificate
<b>1140806</b>	<b>SONO-Y150HVy</b> Round Hardness Blocks, 150±15 HV10, HV1; Ø64x15 mm, Factory Certificate
<b>1141000</b>	<b>SONO-MPA</b> MPA certificate each test block and test force
<b>1141001</b>	<b>SONO-DAKKS</b> Instrument Calibration according to DIN 50159-2 with Certificate Delivery time: approx. 3 weeks
	<b><u>Hardness Reference Blocks, please ask for delivery time!</u></b>
	<b><u>Hardness levels between 150HV and 900HV or 25 HRC and 67 HRC.</u></b>
	<b><u>xxx= Hardness value, y=test load in kgf</u></b>

### Training

<b>11505</b>	<b>SONO-THT</b> Introduction into hardness testing and Instruments operation, plus travel expenses, living, per hour
<b>11506</b>	<b>SONO-TR</b> Group training Hardness Testing, Instrument Operation, per day and person, 4 individuals max., plus travel expenses



## 11.2 Technical Data – SonoDur2

Measuring Specifications						
Measuring principle	UCI Method, corresponds to DIN 50159, ASTM A1038					
Test indenter	Vickers diamond 136°					
Test loads Newton scale (1kgf = 9.81 N)	Motor probes: 1N (0.1 kgf), 3N (0.3kgf) and 8.6 N (0.8 kgf) Handheld Probes: 10N (1 kgf), 49N (5kgf), 98N (10kgf) (Other test loads on request)					
Hardness scales and range (according to relevant standards), in this case table A1 respectively T1, T2 (low alloy steel). Different measuring ranges are valid for other materials. When exceeding the limits the conversion range will be extended. The calculated values are highlighted in red besides the original data in HV. <b>Note:</b> Conversions are acc. to latest ASTM E140-12b <sup>E1</sup> (2013) und EN ISO 18265:2014. Conversions into tensile strength: 98N (10kgf) test load only.	Vickers	HV	10 – 1999 (9999)			
	Brinell	HB	76 – 618			
	Rockwell	HRB	41 – 105			
	Rockwell	HRC	20,3 – 68			
	Rockwell	HRE	70 – 108,5			
	Rockwell	HRF	82,6 – 115,1			
	Rockwell	HRA	60,7 – 85,6			
	Rockwell (EN ISO 18265 only)	HRD	40,3 - 76,9			
	Rockwell	HR45N	19,9 – 75,4			
	Knoop (ASTM E140 only)	HK	87 – 920			
Shore (ASTM E140 only)	HS	34,2 – 97,3				
	Tensile strength	MPa	255 - 2180			
Measurement uncertainty*	< 4 % (HV5, HV 10). For other test loads and ranges see table below.					
Relative repeatability*	< 5 % (HV5, HV 10). For other test loads and ranges see table below.					
*exceeds DIN 50159, dependent on test load and range (see table below). Specifications are valid for 5 measurements using Vickers reference blocks and according to test conditions given in standard DIN 50159.						
Hardness scale	Measurement uncertainty [%]		Relative repeatability [%]			
	< 250 HV	250 HV - 500 HV	500 HV - 800 HV	> 800HV	< 250 HV	> 250 HV
HV 0,1	5	6	7	8	8	6
HV 0,3	5	6	7	8	8	6
HV 0,8	4	4	5	6	8	6
HV 1	4	4	5	6	8	6
Mechanical and Environmental (Instrument and probe)						
Operating time	>8 hours in measurement operation (depending on system performance, temperature and instrument settings), up to 6 hours continuous operation, quick exchangeable battery pack					
Operating Temperature	Probe: 0°C to ~ +50°C Instrument: -10° ~ +50°C // Charging +10°C ~ +45°C					
Storage Temperature	-20°C ~ +60°C					
Humidity	Max. 90%, non-condensing					
Dimensions	Instrument ca. 153x78x29 (26) mm Motor probe Ø38mm, L=190 mm Handheld probe Ø25 mm, L=176 mm (free length oscillation rod ca. 12,5 mm) Handheld probe Ø25 mm, L=207 mm (free length oscillation rod ca. 43 mm)					
Weight	Instrument ca. 280 gr Handheld probe ca. 280 gr Motor probe ca. 370 gr					

Instrument	
<b>Processor and Memory</b>	TI Cortex A8 / 256 MB SDRAM / 512 MB Flash / micro SD Card up to 32 GB
<b>Operating system</b>	Windows Embedded Handheld (WM 6.5)
<b>Keypad</b>	Keypad (21-key-Mobile alphanumeric keypad with backlight) and full alphanumeric software keyboard
<b>Power</b>	Main battery: 3,7V / 2600mAh, LiPo hard pack, quick exchange Charging time: <2h to 80% capacity (Instrument off) Shelf Hours: Up to 6 month AC Power supply/charger: 90V to 264VAC 50/60Hz to 5VDC
<b>Display</b>	3.5" sunlight readable color TFT (320x240) with resistive touch screen, high brightness LED-backlight (440 Cd/m2), adjustable
<b>Interfaces</b>	USB1.1 (Host and Device), micro SD-card, WLAN, Bluetooth version 2.1 +EDR,CLASS2
<b>Dust / Water-splash proof</b>	IP54 level (compliant with IEC60529 standard)
<b>Drop test</b>	1.22-Meter / 4 Feet Drop Threshold
<b>Tumble Test</b>	150 1.65 ft./0.5 m tumbles (equivalent to 300 consecutive drops) at room temperature; meets and exceeds applicable IEC tumble specifications
<b>Vibration Test</b>	MIL-STD 810G Method 514.5, figure 514.5C-1; 1 hour per axis
<b>Instrument Language</b>	D, EN, FR, PL, CZ, CN - more on request

**Table 11-1**

## 11.3 Hardness Scales and Limits

### Conversion limits:

The Vickers scale is the basis for all conversions. Currently, the conversion tables for low-alloy steel are entered. Depending on the specific requirements, conversion ranges and new material tables can be generated.

Measurement range, in HV (UCI): 10 – 2000 (1 - 9999)

Minimum conversion: 80 HV = 76 HB, maximum conversion: 940 HV = 68 HRC (for low-alloy steel, table A1 EN ISO 18265).

### **Conversion rules according to EN ISO 18265 for low-alloy steel:**

Scale	HB	HRB	HRF	HRC	HRA	HRD	HR45N	Rm [MPa]	HK
Min	76	41	82,6	20,3	60,7	40,4	19,9	255	-
Max	618	105	115,1	68,0	85,6	76,9	75,4	2180	-

Table 11-2

### **Conversion rules according to ASTM 140-07 for low-alloy steel:**

Scale	HB	HRB	HRF	HRC	HRA	HRD	HR45N	Rm [MPa]	HK
Min	100	55	88,2	20,0	37,2	40,1	19,6	-	112
Max	739	100	99,6	68,0	85,6	76,9	75,4	-	920

Table 11-3



### **Attention:**

Conversion tables according EN ISO 18265 and ASTM E140 are defined over different ranges for different material tables. For all SonoDur instruments the Vickers scale (HV) is the reference scale and for every measurement there is always a Vickers value. If there exists no pairs of values in HRC, HB etc. for conversion, a value will be generated using extrapolation algorithm. If this is unsuccessful, the user should switch to another hardness scale or select the Vickers scale. Values which are generated by extrapolation algorithm are not covered by standards and do have a higher uncertainty. Therefore these values are displayed in red and it is up to the user to decide whether to use these values or not.

## 11.4 Formulas and Terms

Section 7.5 “Information Menu”, contains calculation results that are described in detail below (see also EN ISO 18265).

Limits:	49.1	HRC	52.3
N:8	<:1	6	>:1
$\bar{x}$ :51.9		$\sigma$ :3.5	6.7%
Max:60.2	Min:49.0	R:11.2	23.3%
Cp: 0.15	Cpk: 0.03		Cal: Off

Figure 11.1

Average value in Figure 11.1 is represented by the letter X with a bar over it, here referred to as “Overline X”.

$$\text{Overline X} = \frac{1}{N} * \sum_{i=1}^N X(i) \quad (1)$$

With X(i) = Individual Hardness Measurement Value, N = Total Quantity of Measurements

If hardness gradient measurements are not performed, the average value is usually the characteristic degree of hardness for a material or for a particular test position on the test object. Impacts caused by the operator and/or material inhomogeneity effects can be reduced by averaging. (Highly heterogeneous materials such as GG or GGG-cast iron are an exception).

R = Range/spread or maximum error in a series of measurements (absolute value):

$$R = X(\text{Max}) - X(\text{Min}) \quad (2)$$



**Please note:**

Relative range is defined dependent on the used scale according EN ISO 18265:

$$R [\%] = \frac{R}{\text{Overline X}} * 100 \quad (\text{for HV, HB, HK, MPa}) \quad (3)$$

$$R [\%] = \frac{R}{100 - \text{Overline X}} * 100 \quad (\text{for HRC, HRA, HRD, HRN}) \quad (4)$$

$$R [\%] = \frac{R}{130 - \text{Overline X}} * 100 \quad (\text{for HRB and HRF}) \quad (5)$$



The range enables the trapping of individual faulty measurements that can be deleted, whereas the distribution of measured values within a series of measurements has to be taken additionally into account. The respective test requirements and procedures must be observed in terms of the deletion of obvious faulty measurements.

Mean error of the single measurement  $\sigma$ :

$$\sigma = \sqrt{\frac{\sum_{i=1}^N (\overline{X} - X(i))^2}{(N-1)}} \quad (6)$$

Or relative mean error of the individual measurement  $\sigma$  [%] from (6):



**Please note:**

Relative mean error of an individual measurement is defined dependent on the used scale according EN ISO 18265:

$$\sigma [\%] = \frac{\sigma}{\overline{X}} * 100 \quad (\text{for HV, HB, HK, MPa}) \quad (7)$$

$$\sigma [\%] = \frac{\sigma}{100 - \overline{X}} * 100 \quad (\text{for HRC, HRA, HRD, HRN}) \quad (8)$$

$$\sigma [\%] = \frac{\sigma}{130 - \overline{X}} * 100 \quad (\text{for HRB and HRF}) \quad (9)$$

The mean error of the individual measurement is an estimation of the individual faulty measurement that contains random components as well as systematic components, such as:

- Individual care and skill when handling the probe by the operators (hand-held measurements, guided measurements by means of stands or probe guidance).
- Testing material properties (local solidification and mechanical stresses, porosity, thermal pre-treatments) as well as geometry (size, mass, thickness, shape, installation position).
- Surface condition (roughness, texture, granularity, machining grooves).
- Environmental influences (temperature, humidity, cleanliness of test object).
- Device specific dispersion.

The mean error of the individual measurement optimally reflects the quality of the test result in its entirety as measured by the above factors.

The process parameters Cp and Cpk:

Both parameters essentially describe the process capability, mainly in automated test facilities and when measuring large quantities.

Cp describes the dispersion of the measured values ( $\bar{X}_i$ ) around an average value  $\bar{X}$  within an admissible tolerance range (upper and lower thresholds  $T_{max}$ ,  $T_{min}$ ). The formula reads as follows:

$$C_p = \frac{T_{max} - T_{min}}{6\sigma} \quad (10)$$

With  $\sigma$  = mean error of an individual measurement and  $6\sigma$  = width of normal distribution curve.

As already mentioned, the application of this formula requires the presence of a large number of measured values, which come close to a normal distribution.

The position of the measured value distribution is characterized by the second parameter Cpk. The distance of the average value  $\bar{X}$  to the respective closer threshold value ( $T_{max} - \bar{X}$ ) or ( $\bar{X} - T_{min}$ ) across half of the distribution width of the Gaussian distribution curve will be correlated herewith.

$$C_{pk} = \frac{T_{max} - \bar{X}}{3\sigma} \quad \text{or} \quad \frac{\bar{X} - T_{min}}{3\sigma} \quad (11)$$

depending on which difference is smaller.

A negative sign indicates that the process has moved beyond the tolerance limits. For further considerations it is referred to relevant literature.

### 11.5 Compliance with Environmental Constraints

NewSonic actively participates in the take-back initiative applicable in Europe, "Waste Electrical and Electronic Equipment" (WEEE) Directive 2002/96/EC.

The test device contains an integral li-ion accumulator (lithium-ion accumulator) that could harm health and/or environment in case of improper disposal, and therefore must not be disposed as unsorted household waste within the European Union.



#### **Attention:**

Therefore, please always return the device to the manufacturer NewSonic, even after the period of product durability has expired!

### 11.6 Limited Warranty

For a period of two (2) years from the date of purchase, we warrant that this instrument will be free of any claim of ownership by third parties, (ii) when new, be free from defects in material and workmanship and perform in accordance with the product's specifications under normal use and service for the applicable warranty period, following the date of sale. The second year of this warranty is only valid, if the instrument is calibrated either by us or one of our certified service providers to values within the provided specifications, after month twelve of ownership, but before month fourteen begins. The duration of the warranty may be extended or modified by explicit service contracts.

This limited warranty shall not apply to any problems arising from (i) failure to follow the product instructions or failure to perform preventive maintenance, (ii) service, repair or modification by someone other than us or one of our authorized service representatives; or (iii) external causes, such as accident, abuse, misuse, or problems with electrical power.

This warranty does not cover parts identified as wear-and-tear parts or lamps, transducers, tubes, accessories, or optional equipment not manufactured by us, which possibly may be covered by separate manufacturers' warranties. Our obligation under this warranty is limited to the repair or replacement of components determined by us to be defective within the warranty period at no cost to the original purchaser. Customer shall arrange for delivery to us in approved packing material. This warranty extends to the original purchaser and cannot be assigned or transferred to any other party.

EXCEPT FOR THE WARRANTY SET ABOVE, WE EXPRESSLY DISCLAIM ALL WARRANTIES AND REPRESENTATIONS OF ANY KIND WITH RESPECT TO OUR PRODUCTS, WHETHER EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, NON-INFRINGEMENT, TITLE AND ANY WARRANTIES ARISING FROM COURSE OF PERFORMANCE, COURSE OF DEALING OR TRADE USAGE.

## 12 Accessories

### 12.1 SONO-PM-4, Prisms Attachment Kit for Motorized Probes

This manual describes the use of the prism attachments for motorized probes of the SonoDur2 product family. The operation of the motorized probes is described in the SonoDur2 instruction manual. Knowledge about such devices is required.

#### 12.1.1 Technical Data and Components

The prisms attachment kit consists of a special probe base with screw thread, featured with four levels to enable the best possible adaptation to curved surfaces as well as three pre-fitted plates and one plate for flat surfaces that can be screwed onto the special probe foot.

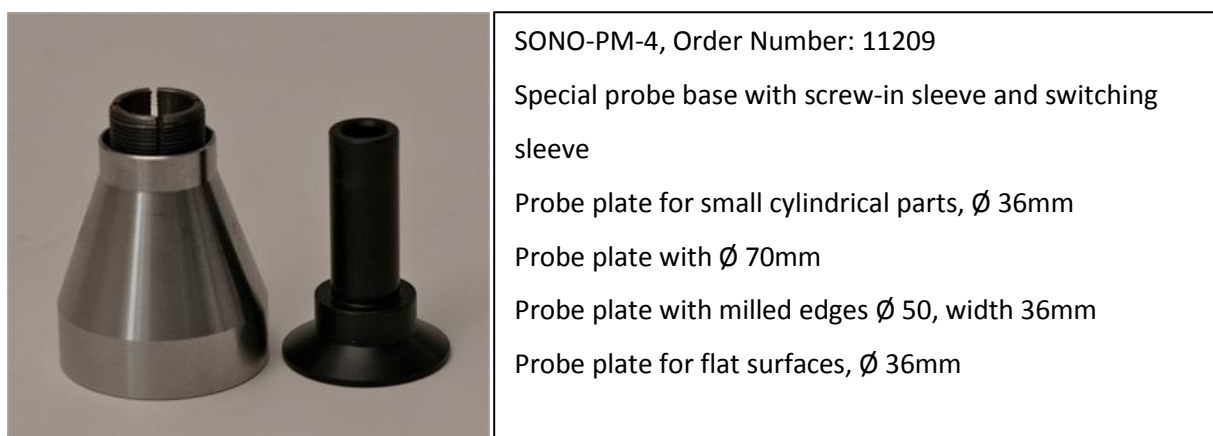


Figure 12.1



Figure 12.2



### Attention:

The switching sleeve of the special probe base (see right figure below) is differently designed than the standard probe base and should therefore not be mixed up.



**Figure 12.3**      Standard probe base

**Special probe base**

#### 12.1.2 Handling

To start with, gently unscrew the standard probe base. Select the desired probe plate and screw it into the special probe base by paying attention to the engraved spacer rings. These indicate the possible diameter range for each test specimen, as shown in Table 1, which applies to all probe plates. After screwing it onto the motorized measuring probe, the special probe base is ready to be used for curved surfaces.

Just like when using the standard probe base, the operating mode can be selected to automatic measuring via the switching sleeve or manual measuring without the switching sleeve. In order to do that, the switching sleeve must be taken out of the special probe base. Triggering the initiation of measurement cycle is now only possible by touching the probe symbol on the SonoDur2 screen, which however, simplifies the exact positioning.

The probe plate for flat surfaces serves the same purpose as the standard probe base and permits fast and simple switching between different probe plates.



Ring	Possible Diameters
3 (top)	From 0 to 10 mm
2	From 10 to 50 mm
1	From 50 to 100 mm
0 (bottom)	From 100 until even
Measured each time for the ring on the vision reference block of the probe base, located in opposite to the lower rim of the probe base.	

**Figure 12.4**

**Table 12-1**

The spacer rings define the possible diameter range according to Table 12.1.



### Attention:

Incorrect diameter setting causes that the motorized measuring probe spring force is either too low or too high and thereby increases the risk of erroneous measurements. If the diameter is set significantly too high, the Vickers diamond may possibly not reach the test object surface and an error message will be issued. ([Section 7.4.1 - Carrying out of Measurement by Means of Motorized Probes](#)).

Once the correct diameter adjustment has been made, carefully place the probe with the notch in longitudinal direction of the cylindrical surface and wait for the measurement process.



**Figure 12.5**



### Attention:

Please ensure that the measuring probe rests fully and is firmly tightened during the measurement performance.

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