ULTRASONIC HARDNESS TESTER

Hardy*Test* UCI1500

Hardy*Test* UCI3000

Manual

1 DESCRIPTION OF THE HARDNESS TESTER

1.1 Usage of the Hardness Tester

The **Hardy***Test* UCI1500/UCI3000 is the product of choice to measure the hardness of metallic materials. To do so it uses the Ultrasonic Contact Impedance Method.
The gauge is applicable for:

- Heat-resistant, corrosion-resistant stainless steel and certain other types of steel
- Non-ferrous metals and alloys
- Specialized cast iron
- Consolidation layers as well as other types of layers on steel products such as cementation, nitrating or induction hardening
- Galvanic coatings (chrome)
- Articles made of fine-grained materials (local study of material properties)

1.2 Technical Specifications

Measuring range - main scales (units):	
Brinell	90 - 460 HB
Rockwell C	20 - 70 HRC
Vickers	240 - 940 HV
Accuracy:	
Brinell	
Area (90…150)HB	±10 HB
Area (150…300)HB	±15 HB
Area (300…450)HB	±20 HB
Rockwell C	±2 HRC
Vickers	
Area (240…500)HV	±15 HV
Area (500…800)HV	±20 HV
Area (800…940)HV	±25 HV
Measuring range - informative scales (units):	
Breaking stress σv	350…1500 MPa (N/mm²)
Rockwell A	70,5 - 85,5 HRA
Rockwell B	51 - 100 HRB
Shore D	35 - 102 HSD
Dimensions - Gauge (L x W x H):	
UCI 3000	125 x 70 x 40 mm
UCI 1500	150 x 80 x 30 mm
Mass - Gauge:	0,3 kg
Dimensions - Probe (Height x Diameter):	
A(50N), H(10N), C(100N)	145 x 25 mm
K(50N)	70 x 30 mm
AL(50N)	170 x 25 mm
Mass - Probe:	0,3 kg

Pressing force - Probe:	
Type A, K, AL:	50 Newton
Type H:	10 Newton
Type C:	100 Newton
Operating temperature:	-10 to +40°C, <90 %
Correction of scale (quantity):	5 per scale
Additional scales (quantity):	3
Average measuring time:	2 Sec.
No. of measurements for calculation of average:	
UCI 3000	1 – 99
UCI 1500	1 – 20
Statistical Data (only UCI 3000):	Max, Min, Standard Deviation, Average
Additional information shown on the display:	
UCI 3000	Individual measured values, values from the additional statistical evaluation
UCI 1500	Individual measured values
Correction – No. of samples:	1 or 2
Scales – No. of samples:	From 2 to 10
Interpolation of scales:	Linear or parabolic
Memory capacity (No. of values)	
UCI 3000	12400
UCI 1500	6000
Max blocks:	
UCI 3000	100
UCI 1500	30
Port to PC:	USB
Auto. Shutdown:	After 0.5, 1, 2, 3, 4 or 5 Min.
Power supply:	
UCI 3000	3,7 Accumulator, USB charger
UCI 1500	9V E block battery or accumulator, charger

1.3 Extent of Delivery

Basic:
Gauge
Testing probe
Charger
USB cable
Software
Manual
Case

Additional (optional):
Additional probes A, H, C, K, AL
Convex adapter

1.4 Probes of the Gauge

The gauge normally gets delivered with a 50N (type A) or a 10N (type B) probe. For special purposes it is also possible to order a 100N (type C), a shorter 50N (type K) or a longer 50N (type AL) probe. For operations on curved surfaces we advice you to use the convex adapter (only available for type A, H, C).

1.5 Measuring Principle

The UCI principle measures the hardness of a certain material based upon the size of an indentation that a Vickers diamante leaves on the material. The contact area is detected electronically by determining the displacement of an ultrasonic frequency. In essence, a UCI probe consists of a Vickers diamond, which is attached to the end of a metal rod. This rod gets inducted by a piezo-crystal to a longitudinal vibration with a resonant frequency of about 70 kHz. If the defined load works on the material it comes to a shift of the resonance frequency. The basis for the UCI hardness test is the relationship between the frequency shift and the hardness of the material. The determined frequency shift is proportional to the contact area of the Vickers diamond on the test material and thus with the size of the indentation. The softer the test material, the deeper the penetration of the diamond. In turn, a large contact area, leads to a high frequency shift. The change in resonance also depends upon the elasticity of the material. That is why the calibration of the gauge has to be adjusted for different materials.

1.6 Requirements for the Object Measured

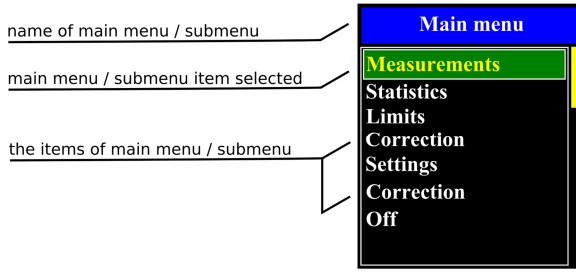
In order to ensure reliable measurement results the test piece has to fulfill following requirements:

Minimum weight	1 kg
Minimum thickness of the test section	2 mm
Maximum surface roughness	Ra = 1.6 µm
Minimum curvature radius of the convex	4 mm
Minimum curvature radius of the concave	6 mm
Minimum surface	3 x 3 mm

1.7 Usage of the Gauge

All settings are made via the menu, which is accessed by pressing the MENU button . The units of measurement (scales) can be set with the help of the following keys: HV, HB, HRC, , .The additional corrections to the scales are selected via , . See 2.5 for more on that topic.

The following picture shows the main menu:

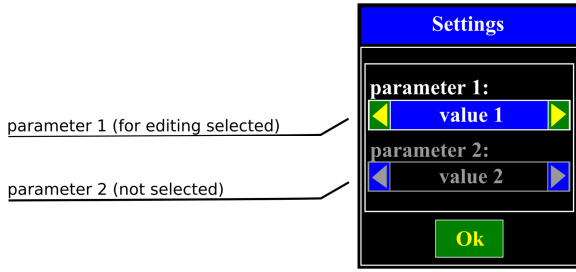


Picture 1

To navigate through the menu use the arrow keys ⇧, ⇩. To enter into a selected submenu press the ENTER ⏎ key. In order to go back use the MENU key 🗎.

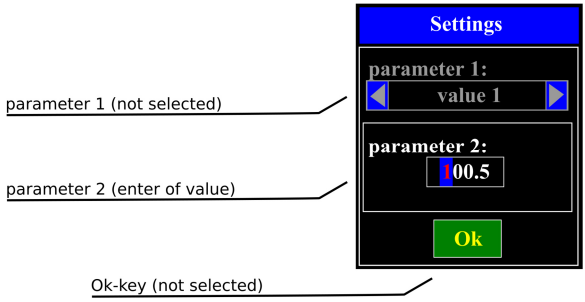
1.8 Setting Procedure

The individual settings are held in the window for parameter input. Some may be selected from a list of specifications. Others such as the name of a measurement block can be entered using numbers and letters. Picture 2 shows an example using the parameter window



Picture 2

In order to change parameter 1 use ⇦, ⇨, wherein for switching between parameter 1 & 2 use ⇧, ⇩.
If it is an alphanumeric value (as with parameter 2 in picture 3), use the arrow keys. The keys ⇧, ⇩ set the desired ASCII characters.
⇦, ⇨ are used to change the cursor. If all entries are correct, apply them using ENTER ⏎.

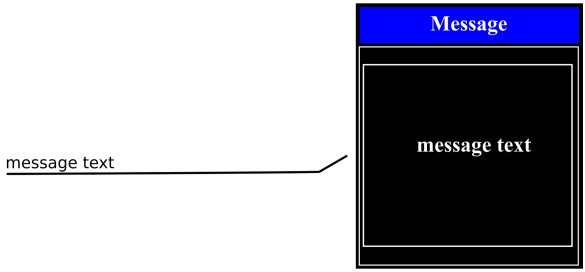


Picture 3

The window gets closed pressing .

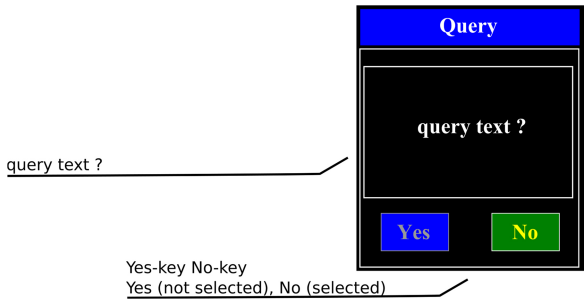
1.9 Notifications

While changing some settings certain notifications may show up.



Picture 4

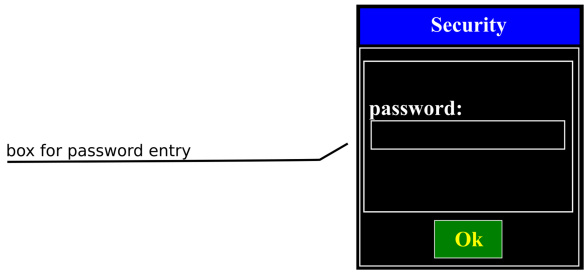
Certain changes have to be confirmed pressing, “Yes”.



Picture 5

1.10 Security/PIN-Code

For some changes it is required to enter a PIN-Code (e.g. changing the corrections/scales).



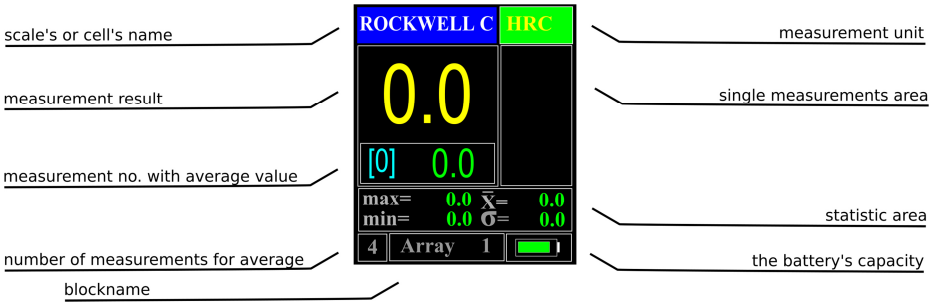
Picture 6

The PIN-Code is as followed: ⇦, ⇨, ⇧, ⇧, ↵.

2 OPERATIONS

2.1 Preparation and Activation of the Gauge

Before starting operations, please ensure that there is no mechanical damage to the electronics section, the probe and the connecting cable.
If necessary, charge the battery by connecting the charger to the front USB port. The probe should be connected with the gauge using the cable included in the delivery (look for the red dots when connecting). To turn on the unit press the ⏻ button.
The following display appears:



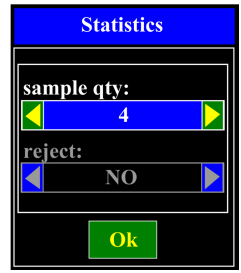
Picture 7

If the gauge gets turned on without connection to the probe, the display will show the main menu.

2.2 Before Measuring

Using HV, HB, HRC, ⇧, ⇩ pick a measurement scale or an additional correction (⇦, ⇨). Go on menu <STATISTICS> - <AVERAGE> to set how much sample points are needed in order to compute the average (Picture 8). Additionally it is possible to adjust the following settings under the menu point <REJECT>

- NO: No sample points are being rejected to compute the average.
- 2σ: All outliers, which are not within two standard deviations from the mean, are not considered for the computation of the average.
- EXTREMES: If there are more then five sample points the min & max values are not being considered for the computation of the average.



Picture 8

2.3 Hardness Measurement Procedure

Carefully put the testing probe perpendicular to the surface of the test product. Then press the probe against the specimen until it stops. After the beep, withdraw the probe from the surface. The measured value appears on the display.

CAUTION!!!

- Place the probe carefully on the test piece. In any case, don't beat the probe against the test piece. This can lead to abrasion of the diamond tip and failure of the probe.
- Do not carry out several measurements at the exact same point on the test piece. The probe should always be slightly moved. Otherwise, this can lead to measurement errors.

2.4 Additional Settings

2.4.1 Display Modification

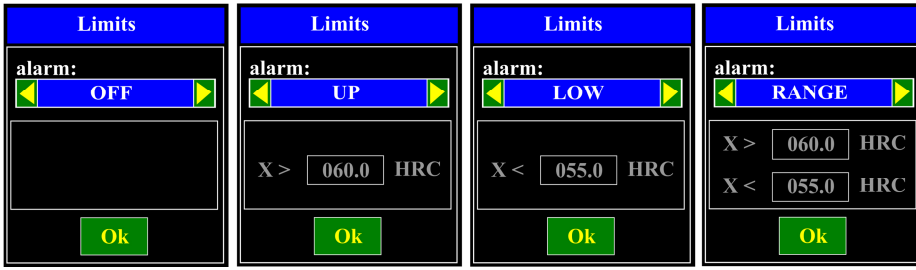
Go to the menu and then on <STATISTICS> - <INFORMATION> in order to enable or disable the measurement history & the statistical values shown on the measurement display.

2.4.2 Limit Setting (only UCI 3000)

It is possible to set limits which alert the user while measuring if:

- The result is greater then the limit set;
- The result is smaller then the limit set;
- The result is out of the defined interval;

The corresponding settings are to be found in the menu under the section <LIMITS>



Picture 9

2.4.3 Memory

The gauge posses a memory function to save the results obtained. On the one hand it is possible to transmit the results to a PC and to analyze them their. Alternatively the saved results can be analyzed on the gauge itself. The memory is organized in blocks (arrays) where the results can be found.

The following activities can be performed within the memory function:

- Creation, deletion, and designation of the blocks;
- Selection of measurement scales for the blocks
- Display of the data obtained;
- Statistical data analysis (only UCI 3000);
- Graphical data analysis (only UCI 3000)

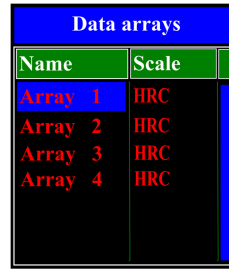
Enter the memory function through the menu going on <MEMORY>.

2.4.3.1 Create a Block

Within <MEMORY> go on <ADD ARRAY> and enter the name & the scale of the block so that a block gets created. The new block can be found under <DATA ARRAYS>

2.4.3.2 Block Activation

In order to save results in a block it is first necessary to activate the block of choice so that the data gets memorized in the right place. To do so select <MEMORY> - <SET ARRAY>. A list with all created blocks will be displayed (Picture 10). Go on the respective block and press ⏎ to activate it. From now on all results will be memorized in that particular block. Note that the name of the activated block will be shown on the bottom of the measurement display.



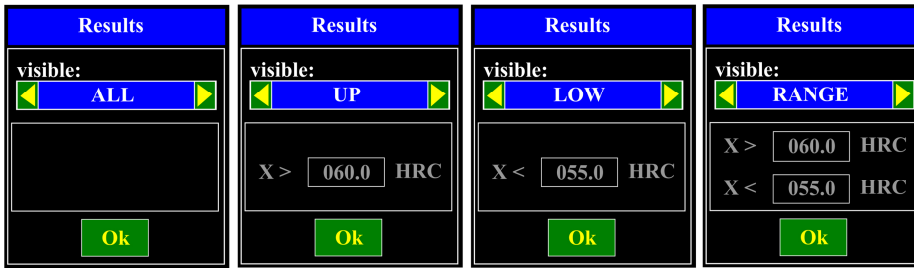
Picture 10

2.4.3.3 Saving Results in a Block

Results get directly saved through the measurement display. After measuring simply press and hold . The mean of the past measuring series gets saved in the activated block.

2.4.3.4 Display of Saved Results

In order to display the saved results go on <MEMORY> - <DATA ARRAYS> - <ARRAY "X"> - <RESULTS>.



Picture 11

It can be selected if:
- All results should be shown;
- Only results above a particular value should be shown;
- Only results below a particular value should be shown;
- Only results within a certain interval should be shown;

2.4.3.5 Delete Memory

To delete to whole memory go on <MEMORY> - <CLEAR MEMORY>

2.4.3.6 Delete Blocks

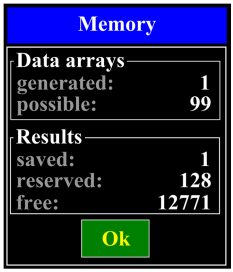
To delete a block go on <MEMORY> - <DELETE ARRAY> and select the block.

2.4.3.7 Clear Blocks

When a block gets cleared only the data within that block gets deleted, not the block itself. Go on <MEMORY> - <CLEAR ARRAY>.

2.4.3.8 Memory Information

Going on <MEMORY> - <MEM CONDITION> one can get several information about the memory (Picture 12).



Picture 12

2.4.3.9 Change Block Name

Go on <MEMORY> - <DATA ARRAYS> - <ARRAY X> - <NAME>.

2.4.3.10 Data Analysis (only UCI 3000)

The gauge is able to conduct statistical analysis like:

- Computation of mean, standard deviation, min. & max value;
- Comparing the data to a default value. This includes the deviation of the mean to the default value, no. of sample points above & below the default value and the deviation from the max/min value to the default value.
- Comparing the data to default interval.

In order to enter the analysis mode go on:
<MEMORY> - <DATA ARRAYS> - <ARRAY “X”> - <ANALYSE>.

For the graphic representation go on:
<MEMORY> - <DATA ARRAYS> - <ARRAY “X”> - <GRAPHIC>.

2.4.4 Data Transmission to PC

In case that it should be necessary to transfer the saved data from your gauge to a PC the software TKM Link is included in the delivery. In order to install the software under Windows, carry out following instructions.

2.4.4.1 Installation of Hardware Driver

First of all it is necessary to install the hardware driver.

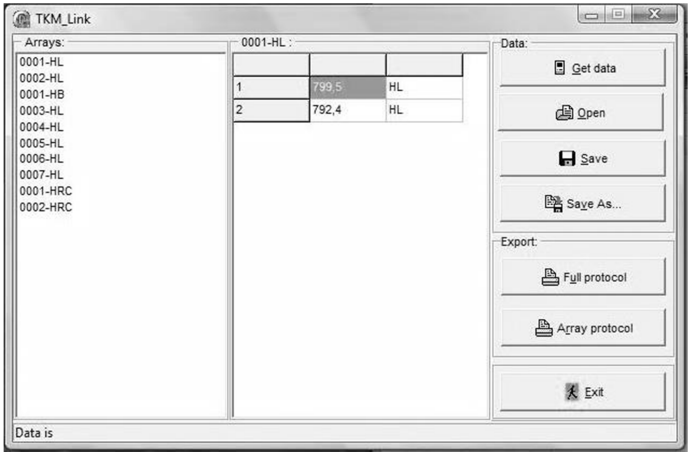
Insert the CD and open the volume.

-Open the folder ***Driver*** and run ***NDT DriverSetup***.
-Carry out the instructions and reset the PC after finishing the installation.
-After resetting connect the gauge with the included USB adapter to the PC. Windows will show you that it is installing the hardware driver.
-After Windows finishes that process the driver is installed.

Note: To check if the installation proceeded correctly you may go on „System Control“ and on the „Device Manager“ section. In the section „COM & LTP“ ***NDT_Device_MP*** should be listed.

2.4.4.2 TKM Link

After installing the driver for the UCI you may transfer your saved measurements. Go again on the CD and start ***TKM Link***. You can also copy the application on your hard disk and start it from there. An additional installation is not necessary. Following window will open:



Picture 13

The left column shows all groups of measurements, the mid one shows the measurements included in every group and the right one shows all possible commands.

Get data: This command transfers the data from the gauge to the PC.

Open: With *Open* you can open old transmissions that were saved on the PC.

Save: The command „Save“ will be executed.

Save as: The command „Save as „ will be executed.

Full protocol: All groups of measurements will be exported to a Microsoft Word file (if MS Word is installed on the pc)

Array protocols: Just the selected group of measurements will be exported to a Microsoft Word file.

Exit: Exit *TKM Link*.

2.5 Correction of Hardness Scales

2.5.1 General

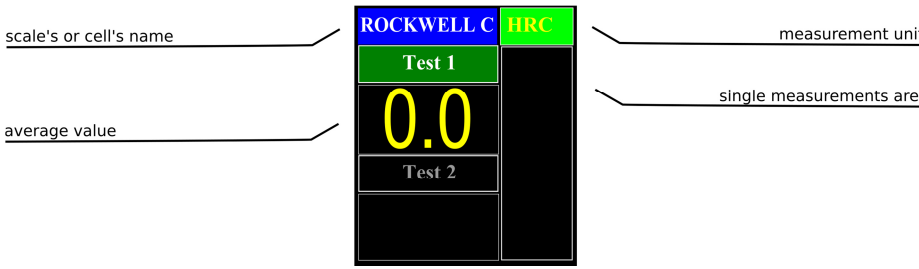
The correction of the scale (as well as the additional correction to the scales) adjusts the hardness indicators on the standard gauges. The purpose of the correction process is to register the improvements into the original factory settings. If an unusual deviation of the measured values is found, caused by the natural wear of the mechanical components, the correction of the scale allows you to improve the accuracy. The additional correction to the scale allows the control of metal products that differ in their characteristics to common construction steels.

ATTENTION!!!

The correction of the main scales is to be performed ONLY when an impermissible deviation occurs. Before correction, ensure that the impermissible deviation was not caused by a previously failed scale correction.
To delete a correction go on <CORRECTION> - <CLEAN> & enter the PIN-Code (see 1.10).

2.5.2 Implementing a Correction

First, the desired scale (measuring unit, ⇧, ⇩) and the correction (⇦, ⇨) has to be selected in the measurement display (e.g. CELL 1, on HRA). Then go on <CORRECTION> - <CORRECTION>. Enter the PIN-Code (See. 1.10). Following window opens:



Picture 14

In the correction mode one has to calibrate the gauge. In order to do so four measurements are to be made on a test piece. The hardness of the test piece has to be known by the operator. If the measured value differs from the hardness of the test piece, one has to correct to outcome using ⇧, ⇩. Subsequently confirm the calibration with ↵.

If the calibration gets confirmed without an adjustment through ⇧, ⇩ the whole process gets canceled and a new correction can be started.

If the correction was successful one can leave the correction mode by pressing 🗎. If a second correction is needed, repeat the process with a different hardness.

Note that a second correction should be only made if the hardness of the second test piece significantly differs from the hardness of the first test piece. If a second correction is calibrated using the same test piece, this will lead to measurement errors.

In that case it is necessary to delete the correction.

While measuring the correction is only active if the selected unit & correction (in this example CELL1, HRA) has been selected in the measurement display. If not (e.g. standard HRA) the correction is not applied on the measurements.

2.5.3 Delete a Correction

To delete a correction go on <CORRECTION> - <CLEAN> & enter the PIN-Code (see 1.10). Note that the right scale & correction has to be selected in the measurement display.

2.6 Scale Calibration

Beside the standard scales (HRC, HV, HB) there are also customized scales, which can be calibrated by the user (SC1, SC2, SC3). The user can literally define his own hardness scale. Using ⇧, ⇩ in the measurement display one can select them. For a calibration several test pieces are needed with significantly different hardships. To edit a selected customized scale go on menu and then <EDIT SCALE>:

- <SETTINGS>: Enter the number of scale points (2 to 10) and the interpolation between the scale points (linear or parabolic)
- <CURVE INPUT>: Enter the scale curve (Probe signal → measured value shown on the display)
- <NAME>: Enter the scale & unit name
- <SENSOR SIGNAL>: Displays the signal of the probe while measuring. Used to define the curve input.

3 DISPLAY-, LANGUAGE-, AND ADDITIONAL SETTINGS

In the menu under <SETTINGS> one can find the brightness, timeout, language and display settings.

4 BATTERY

The battery charge level is shown in the bottom right corner of the measurement display. When the critical charge level is reached the device automatically shuts down and an acustic signal rings.
Use the USB cable to charge the device.

Note: Used batteries are considered hazardous waste and must not be disposed of with normal household waste.

5 SHUTDOWN

The device gets shut down by pressing & holding ⏻, after the timeout time (if device is not used) or via the menu and <OFF>.

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