

# dynaROCK II



**Manual**  
**Version 1.3**





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### 1 Introduction

The dynaROCK II is a portable device for testing the hardness of materials. The measurement is implemented according to the Leeb hardness testing method. Using this method, most metallic materials can be measured within a large measuring range.

For different applications, six impact device types are available. The type of the connected impact device is identified automatically.

Measurements can be made at any angle, even overhead.

The hardness is displayed directly in the hardness scales HRB, HRC, HV, HB, HS or tensile strength (MPa; measurable only with the impact device types D, DC and G). A limit-value acoustic alarm facilitates the evaluation.

The dynaROCK II is provided with a measured value memory in which up to 500,000 measured values, with date, time and measuring parameters, can be stored. The stored series of measurements with the corresponding statistical data can be printed or display at all times.

In addition, the dynaROCK II offers the so-called test report printout. Here the measured values are printed immediately. A statistical evaluation cannot be printed out with it in this case.

## **1.1 Main applications and measuring range**

### **1.1.1 Main applications**

- Heavy workpieces
- Cast parts
- Damage analysis on pressure vessels, steam turbo-generators and other systems
- Bearings and other parts
- Fixed-assembled machines and immovable component parts
- Surfaces of small hollow spaces
- Material allocation in the metal goods storage
- Quick tests over a large area and multi-point measurements on heavy workpieces.

### **1.1.2 Measuring range**

The measuring ranges of the different impact devices are represented in 3 in the appendix.

## 1.2 Scope of delivery

	No	Article	Number	Remark
Standard scope delivery	1	Basic device	1	
	2	Impact device type D	1	Including cables
	3	Hardness comparison block	1	
	4	Cleaning brush	1	
	5	Manual	1	
	6	Case	1	
	7	Interface cable	1	
	8	USB charging adapter	1	
Optional accessories	9	Different special impact devices and placement rings		See Chapter 3 and appendix
	10	Microprinter	1	

## 1.3 Operating conditions

Operating temperature:	0°C to 40°C
Storage temperature:	-30°C to 60°C
Relative humidity:	≤ 90%

The operating area should be free of severe vibrations, strong magnetic fields, corrosive materials and thick dust.

## 2 Manual

### 2.1 Lettering

<b><i>Operating elements</i></b>	Operating elements
KEY	Keys
Standard text	Descriptions and explanations in text form
<b><u>Important notes</u></b>	Important notes and remarks

### 2.2 Text boxes

<b>Operating elements</b>	Explanations of functions and operating elements are framed in blue.
<b>Entry fields</b>	Green fields describe user inputs and parameters
<b>Information</b>	Information and notes are provided with yellow background
<b><u>Important notes</u></b>	Important notes and warnings are represented in red boxes

## 3 Equipment description and measurement process

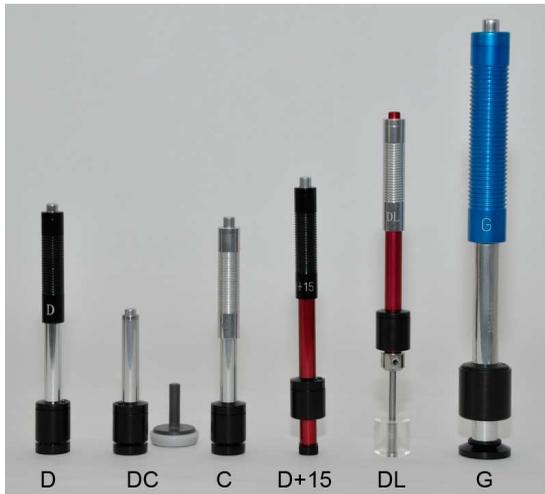
### 3.1 Impact device type D



- 1 - Release button
- 2 - Bolt-arming sleeve
- 3 - Guide pipe
- 4 - Reactance coil part
- 5 - Placement ring
- 6 - Impact body
- 7 - Connection cable

#### 3.1.1 Special impact device types

The technical specifications of the individual impact devices are indicated in Table 4, the requirements on the sample surface in Table 5 and the diameters and depths of the arising impressions in Table 6.



- Type D : Standard impact device for most hardness testing tasks
- Type DC : Extremely short impact device for measurements at inaccessible locations or in pipes
- Type C : Impact device with lower impact energy e.g. for measurements on surface-hardened parts. The impressions are approximately only half as deep as in case of impact device D, however, the requirements on the surface quality are higher.
- Type D+15: The impact device has a recessed reactance coil and a smaller placement surface (11 mm x 14 mm instead of  $\varnothing$  20 mm) for hardness measuring in slots and deepened areas.
- Type DL : Impact device with longer impact body. The diameter of the front pipe is 4.2 mm.
- Type G : The impact energy increased with type G for measurements on heavy casting and forged parts. Measurement only in the Brinell range up to 650 HB. The requirements on the surface are not as extensive as with type D.

### 3.2 Leeb hardness measurement process

The measurement process employed here exploits the difference between the impact and rebound speed of a small impact body. This is fired in the impact device onto the sample surface with an exactly defined energy. The plastic deformation on generating the impression on the sample surface requires energy. Therefore the rebound speed of the impact body is lower than the speed before the impact. Both speeds are measured inductively 1 mm above the surface.

The hardness number is calculated according to the following formula:

$$HL = \frac{1000 * VB}{VA}$$

Where:

HL - Leeb hardness

VB – Rebound speed

VA – Impact speed

From the HL values, hardness numbers in the usual hardness scales are obtained using empirically-determined revaluation tables. These revaluations are dependent on material.

## 4 General notes on the operation

### 4.1 Keys



Switching on/off the device.



Changes the impact direction



Changes the hardness scale.



Changes the material.



Delete last measurement point



Display statistics



Into the main menu



Cursor keys

With these keys, menu items are selected and the required values in fields set-adjusted.



With this key, the current function is exited. The higher-level menu item is accessed.



The processing is completed with this key in a field, or a subordinate priority menu item is selected.

## 4.2 Status indicator line

The rechargeable battery status and the time are displayed in the status indicator line above in the window.

## 4.3 The menus

A menu consists of a list of available menu items and a bar which identifies the already active menu item. This bar can be displaced in the menu with the aid of the cursor keys. As a result of pressing ENTER the marked menu item is selected. Either a window or a submenu are opened by that.

With ESC, a return is made to the former menu.



Illustration 1: Main menu

Special value was not placed on complicating the operation through deeply interleaved menus.

## 4.4 Text entry

In case of saving measuring data and measuring parameters, inputs are possible in plain text. In these cases, the text entry window is opened.



Illustration 2: Text entry

In the upper field (designated as text field in the following) the entered text is displayed, in the rows below are represented the characters which can be selected. The blank is identified with [ ].

Below the characters is located a strip with command buttons for control. These command buttons are allocated as follows:

<b>A/a</b>	Switching between upper case and lower case
<b>OK</b>	Accepting text and closing text entry windows
<b>Cancel</b>	Closing text entry windows without accepting the text

The field on which the focus is placed is identified by a yellow background. With the keys ▲ and ▼ the focus is set on the line above or below the current line. The allocation of the keys is different, depending on which field has the focus at the time.

Action	Key/s
<b><i>Focus on text field</i></b>	
Shift input mark	◀ and ▶
Deletion of the character in front of the input mark	DEL
Accepting text and closing text entry windows	ENTER
Closing text entry windows and asking whether the text should be accepted.	ESC
<b><i>Focus on character area</i></b>	
Selection of the character to the left or right of the current character	◀ and ▶
Entering character in the text field	ENTER
Deletion of the last entered character	DEL
Closing text entry windows and asking whether the text should be accepted.	ESC
<b><i>Focus on command button</i></b>	
Implement action	ENTER
Selection of the command button to the left or right of the current one	◀ and ▶
Deletion of the last entered character	DEL
Closing text entry windows and asking whether the text should be accepted.	ESC

## 4.5 The number field

A number field is used for the input of numbers. It consists of mostly several digits which can be changed separately, and a marker, as well as the cursor which can be displaced with the cursor keys ◀ and ▶ within the number field. The Item on which the cursor is at this time can be modified through pressing the cursor keys ▲ and ▼

A further, leading digit for the input of larger numerical values can be generated by cursor ◀.

The input is saved and concluded with ENTER. With ESC, the entry field is closed without saving.

## 5 Implementation of a measurement

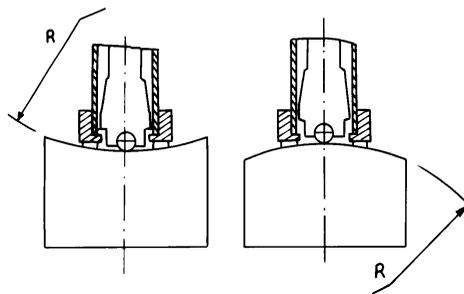
### 5.1 Preparation and control-check before the measurement

#### 5.1.1 Preparation of the sample

The preparation of the sample surface should correspond to the relevant specifications from 5 (on Page 39 in the appendix).

- In case of sample preparation, procedures which can influence the surface hardness of the sample, such as e.g. overheating, cooling etc., should be avoided as far as possible.
- If the surface of the sample is too uneven, measuring errors can occur. The sample surface should shine metallic, be smooth, level and free of dirt and oil.
- Underlay for test specimens:
  - In case of heavy test specimens, no underlay is necessary (see 5 (Page 39 in the appendix): *Minimum weight of the sample*)
  - Test specimens of medium weight require a flat, solid underlay (see 5 (Page 39 in the appendix): *Minimum weight of the sample*)

- The sample must be placed onto the underlay so that it is stable and flush
- In case of measurements on large plates, long rods or curved work pieces, the impact effect of the impact device can cause small deformations or vibrations which lead to measuring errors, also when the weight of the sample corresponds to the specifications in 5 (on Page 39 in the appendix). In such cases, the sample should be reinforced or supported on the opposite side of the measuring point.
- In the ideal case, the sample surface should be level. In case of surfaces with a radius of curvature  $R < 30$  mm (with impact devices of the type D, DC, D+15, and C) and  $R < 50$  mm (with impact devices of the type G), a correspondingly shaped placement ring, which is adapted to the radius of curvature, must be screwed onto the impact device for the secure mounting of the impact device.



*Illustration 3:*

- In case of samples with hardened surface, the case hardening depth should correspond to the specifications in 5 (on Page 39 in the appendix).
- The sample should not indicate any internal magnetism, since this can influence the measurement of the speeds of the impact body.

### 5.1.2 Measuring parameter settings

The required measuring parameters must be set-adjusted according to requirements. It involves the following:

- Material
- Hardness scale
- Impact direction
- Tolerance limits
- Online statistics
- Test report printout

The measuring parameters are described in Chapter 7.

## 5.2 Measurement

Before the measurements, the test device should be checked by means of a hardness comparison block. The precision and repeatability of the measurements should lie within the limits from 2 (on Page 36 in the appendix).

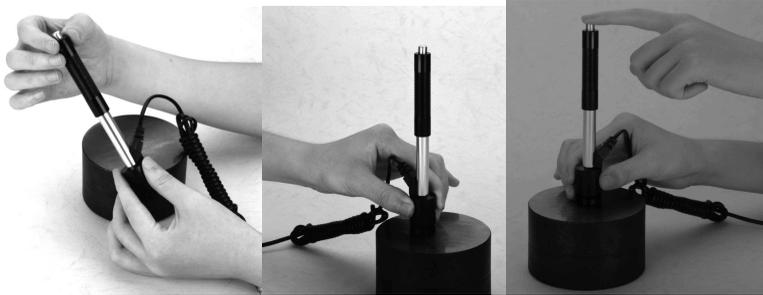
***Note: The hardness of the comparison block is indicated on the block. Hardness comparison blocks with DKD certificate are available in three different hardnesses. When the measured values of the dynaROCK II deviates from the hardness of the comparison block, the device must be calibrated.***

### 5.2.1 Operational startup

- Connecting impact device
- Press the red activation key to switch on the device. With the start, the last set-adjusted measuring parameters are loaded (see Chapter 7). The device is now ready for measurement.

### 5.2.2 Preparation of the impact device

Slide the bolt-arming sleeve down slowly and uniformly to the stop. Then slowly bring the bolt-arming sleeve into the starting position again.



### 5.2.3 Mounting the impact device

Press the placement ring of the impact device firmly and without wobbling onto the test specimen. The impact direction must correspond to the set-adjusted direction.

### 5.2.4 Measuring

Press release button above on the impact device. Sample and impact device must be held steady and stable in this case.

For every measuring point, 5 measurements should be carried out whose deviation should not exceed  $\pm 15$  HL .

The minimum distance between two measuring points, and the minimum distance between a measuring point and the edge of the sample, should correspond to the specifications in 1.

Impact device type	Separation distance between the center points of two impressions	Separation distance between the center point of an impression and the edge of the sample
	Not less than /mm	Not less than /mm
D / DC	3	5
DL	3	5
D+15	3	5
G	4	8
C	2	4

Table 1

The measurement is completed with the acoustic signal.

If the Leeb hardness is to be converted into another hardness scale, a benchmark comparison test must be carried out in order to obtain a suitable conversion factor for the corresponding material. Test measurements are carried out on the same sample with a well calibrated Leeb hardness testing device, and with another hardness tester, according to the required hardness scale. For every hardness number, 5 measurements with the Leeb hardness testing equipment must be carried out, uniformly distributed around a hardness impression of the other hardness testing device. At least three hardness impressions should be measured. The average value of the Leeb hardness and the average value of the measured values in the other hardness scale are used for the generation of a comparison hardness curve. The comparison hardness curve should be calculated from at least three series of corresponding values.

## **6 Operation of the device**

### **6.1 Switching-on**

Press the red activation key to switch on the device.

If an impact device is connected, then the type of the impact device is identified automatically and the device goes into measurement mode. At this point it should be checked whether the impact device type has been identified correctly.

### **6.2 The measurement window**

If an impact device is connected, the measurement window is displayed after switching on.

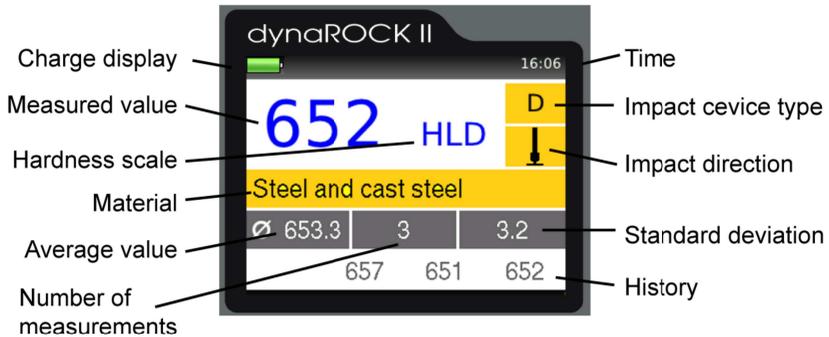


Illustration 4: Measurement window

### 6.2.1 Description of the measurement window

<b>Charge status display:</b>	Displays the residual charge of the batteries.
<b>Time:</b>	Current time
<b>Measured value:</b>	Current measured value
<b>Hardness scale:</b>	Current hardness scale
<b>Material:</b>	Current material
<b>Impact device type:</b>	Type of the connected impact device
<b>Impact direction:</b>	Selected impact direction
<b>Number of measurements:</b>	Number of measurements already carried out
<b>Average value:</b>	Average value of the measurements carried out
<b>Standard deviation:</b>	Standard deviation
<b>History:</b>	The last 4 measured values are displayed here

### 6.2.2 Measurement procedure

If the measurement window is displayed, a measurement can be carried out. The result of measurement is displayed immediately according to measurement implemented. The number of decimal places indicated is dependent on the hardness scale. The Rockwell scales are usually indicated with 1 decimal

place, Vickers, Brinell, Shore and tensile strength without any decimal place. If the measured value lies within the tolerance limits, a beep is emitted, otherwise 2 short tones.

### 6.2.3 Key layout of the measurement window

DIR	Changes the impact direction
SCALE	Changes the hardness scale. If the tolerance limits cannot be converted into the new scale, they are automatically set to 0. However, the values set-adjusted in the measuring parameters are stored so that, in case of renewed changeover into a scale in which the limits can be converted, these are again set to the adjusted values. In the system settings it can be determined whether the scale should be changed automatically or a dialog should be opened (see 9.4.2). <b>Deactivated if the measured value memory is switched on.</b>
MAT	Changes the material. If the currently selected hardness scale is not defined for the new material, the hardness scale is automatically reset to HL. In the system settings it can be determined whether the material should be changed automatically or a dialog should be opened (see 9.4.3). <b>Deactivated if the measured value memory is switched on.</b>
DEL	Deletion of the last measured value
STAT	Display of the statistics concerning the already measured values

### 6.3 Statistics

If the measured value memory is switched on, the values of a series can be evaluated statistically at all times. Even if the measured value memory is not switched on, the hardness numbers are always temporarily stored until the measurement window is closed. Thus a statistical evaluation of the measured values can also be displayed with switched off measured value memory.

If the hardness scale or material is changed by key press in the measurement window, the statistics are reset.

### 6.3.1 Display of the statistics

The output of the statistical evaluation is implemented as soon as the number of measurements set-adjusted in the measuring parameters have been made, or the key STAT is pressed. First to be outputted are average value, standard deviation, relative standard deviation (standard deviation in % of the average value),



dynaROCK II		16:07
neu1		
Mean value	671.8 HLD	
Std. dev.	23.8	
Std. dev. %	3.54	
Minimum	615 HLD	
Maximum	717 HLD	
Number	25	

*Illustration 5: Statistics*

minimum, maximum and the number of values. Standard deviation and average value are outputted with 1 decimal place more than is usual for the hardness scale. The Rockwell scales are usually indicated with 1 decimal place, Vickers, Brinell, Shore and tensile strength without any decimal place. The relative standard deviation is outputted with 2 decimal places.

If the key STAT is pressed again in this view, a window is opened in which are displayed the measured values with which the statistics were calculated. Here it is possible to delete obviously incorrect values.



dynaROCK II		16:07	
neu1	HLD		
695	658	717	650
692	669	640	682
683	615	674	692
679	671	674	674
657	668	691	685
715	627	666	657

*Illustration 6: Individual values*

For the deletion of a value, the marker is set with the cursor key to the value to be deleted and then DEL is pressed.

If the display window is closed with ESC, a request is made as to whether the changes should be accepted or rejected. If the changes are accepted, the statistical values will be newly calculated.

The statistics window is closed with ESC.

## 7 Measuring parameter

### 7.1 Description

After switching on the dynaROCK II, the last employed combination of measuring parameters is always active.

#### **The measuring parameters in detail:**

**Impact direction:** The impact direction is set-adjusted with the aid of the key DIR in the measurement window.

**Material:** The currently selected material.

**Hardness scale:** The current hardness scale into which the measured values are converted as appropriate. In the measurement window the hardness scale can be switched over with the aid of the key SCALE, unless the test report printout or the measured value memory are activated.

**Rating:** Upper and lower limit for the rating GOOD are stored here. If a measured value lies outside of these limits, an acoustic signal is triggered with the measurement (2 short tones). If the measured value lies within the limits, an individual tone indicates the successful measurement. If the value 0 is entered for upper and lower limit, no verification of the measured value is implemented.

The value for the lower limit must of course be smaller than that of the upper limit.

With active rating, the overshooting or undershooting of the limits is displayed in the measurement window.

**Statistics:** The number of measured values which should be statistically evaluated without the use of the measured value memory is defined here. If this number of measured values is reached, the statistics window is opened automatically (see 6.3.1).

Test report printout: If a small test report printer is connected, the line-by-line printing of the measured values here can be switched on and off.

## 7.2 Administration of the measuring parameter sets

### The following are stored:

- The assigned name
- The material
- The hardness scale
- The upper and lower limit for the rating 'GOOD'
- The test report printout (on or off)
- The number of values which should be used for the statistical evaluation

In the dynaROCK II combinations of measuring parameters can be stored under a user-defined name. In this way, the measuring parameters required for specific applications can be called up easily.

### 7.2.1 Editing measuring parameters

Under the menu item **Measuring parameter / Edit**, the measuring parameters can be adjusted.

Only the current measuring parameters can be changed. In order to change a stored configuration, this must first be loaded and stored again after the change has been implemented.

### 7.2.2 Saving measuring parameter

The current measuring parameters can be stored in the menu item **Measuring parameter / Save** under a user-defined name.

According to choice of the menu item, a text entry window is opened in which the new name for the data record can be entered.

### 7.2.3 Loading measuring parameters

Under the menu item **Measuring parameter / Load**, the stored measuring parameters can be called up.

With the cursor keys, the required item is selected from the list of the existing measuring parameter data records and loaded with ENTER.

### 7.2.4 Deleting measuring parameters

Under the menu item **Measuring parameter / Delete**, a stored measuring parameter data record can be deleted if it is not required any longer.

With the cursor keys, the required item is selected from the list of the existing measuring parameter data records and deleted with ENTER.

## 8 Memory functions

In the dynaROCK II, a total of up to approx. 500,000 measured values can be stored. These measured values are organized in series of measurements (series).

A name is assigned to every series of measurements, under which they can be displayed or printed later. The hardness numbers are stored with time, date and impact direction of the measurement. In addition, the measuring parameters are stored with which the series was recorded:

- The impact device type
- The material
- The hardness scale
- The upper and lower limit for the rating 'GOOD'

If the measured value memory is active, material and hardness scale cannot be changed any longer in the measurement window by key press!

In case of printing or outputting of a series of measurements, average value and standard deviation are calculated and displayed.

## 8.1 New Series

In the menu item **Memory functions / New series**, the name of a new series of measurements can be stipulated with the text entry function (see 4.4). On completion of the input, the measurement window is opened and the measured hardness numbers are stored under this name.

The measuring parameters active before the input of the name for the new series of measurements are employed. These measuring parameters cannot be changed as long as the hardness numbers are stored.

The recording of the series of measurements is ended when the measurement window is closed. The request follows as to whether the hardness numbers should be finally stored in this series.

## 8.2 Continue measurement in existing series

Under menu item **Memory functions / Continue series of measurements**, a series of measurements can be selected to which the new measured values are attached. If the series of measurements was begun with an impact device type other than that currently connected, a continuation of the measurement is not possible.

## 8.3 Deleting a series

If series of measurements is no longer required, it can be deleted under menu item **Memory functions / Delete**.

## 8.4 Displaying a series

The content of a series of measurements can be displayed and edited under menu item **Memory functions / Show**, together with the statistical information (see 6.3.1).

## 8.5 Copy to USB flash drive

The measurement series can be copied in CSV format (character set Unicode UTF8) to a USB flash drive under the menu item **Memory functions / Copy**

**to USB flash drive.** Thus it is possible, to call up series, without connecting the dynaROCK II to the computer.

The CSV-Format can be opened by all popular word processing and spreadsheet programs, which allows a comfortable evaluation of the measuring results.

### 8.5.1 Transfer Data

In the menu item **Memory functions / Copy to USB flash drive** the series of measurements, that should be copied on the USB device, can be chosen. All series can be selected and copied at the same time as well.

### 8.5.2 File format

When importing the CSV files in word processing and spreadsheet programs, the character set 'Unicode UTF8' must be selected (the data is separated by semicolons), otherwise the special characters will not be displayed correctly.

The saved data are:

- 1 Number of measurements
- 2 Impact device type
- 3 Material
- 4 Upper limit for rating GOOD
- 5 Lower limit for rating GOOD
- 6 Hardness scale
- 7 reading 1 (Hardness;Impact direction\*;Day;Month;Year;Hour;Minute)
- ...
- n reading n (Hardness;Impact direction\*;Day;Month;Year;Hour;Minute)

\*Impact direction:

- |     |   |
|-----|---|
| 0   |  |
| 45  |  |
| 90  |  |
| 135 |  |
| 180 |  |

## 9 System settings

### 9.1 Language

In the menu item **System / Language**, the language can be selected. As a result of actuation of the cursor keys, the language is selected. After exiting the window with ENTER, the new language becomes active.

### 9.2 Time

Under **System / Time**, the clock of the dynaROCK II can be set-adjusted. The series of digits means HH:MM (Hours:Minutes). The input is accepted with ENTER, with ESC the input window is closed without acceptance of the value.

### 9.3 Date

In the menu item **System / Date**, the date can be set-adjusted. The input is accepted with ENTER, with ESC the input window is closed without acceptance of the date.

### 9.4 Configuration

#### 9.4.1 Date format

Under the menu item **System / Configuration / Date format**, the format in which the date is entered and displayed can be set-adjusted.

Meaning of the alphabetic characters of the format specification:

**DD:** Day  
**MM:** Month  
**YYYY:** Year

#### 9.4.2 Key SCALE

In the menu item **System / Configuration / key SCALE**, it is adjusted whether a dialog for the selection of the new scale should be opened while

activating the key **SCALE** in the measurement window, or whether the hardness scale should be set automatically to the next valid scale.

Select:

- |                    |  |
|--------------------|--|
| <b>Open dialog</b> | If the new hardness scale should be selected in a dialog.                  |
| <b>Next scale</b>  | If the hardness scale should be set automatically to the next valid scale. |

### 9.4.3 Key MAT

In the menu item **System / Configuration / key MAT**, it is adjusted whether a dialog for the selection of the new material should be opened by activating the key **MAT** in the measurement window, or whether the material should be set automatically to the next valid material

Select:

- |                      |   |
|----------------------|---|
| <b>Open dialog</b>   | If the new material should be selected in a dialog.                     |
| <b>Next material</b> | If the material should be set automatically to the next valid material. |

### 9.4.4 Query whether series should be saved

Under the menu item **System / Configuration / Save series query** you can determine if you want to be queried whether the data should be saved when you close the measuring or statistics window. Select 'Off' to turn off the query and 'On' otherwise.

#### 9.4.5 Query whether values should be printed

Under the menu item **System / Configuration / Print values query** you can determine if you want to be queried whether the data should be printed when you close the statistics window. Select 'Off' to turn off the query and 'On' otherwise.

#### 9.4.6 Tensile strength unit

Under the menu item **System / Configuration / Tensile strength unit** it can be selected if the unit of tensile strength should be displayed as Mpa (Megapascal) or N/mm<sup>2</sup> (Newton per square millimetre).

### 9.5 Impact device calibration

The menu item **System / Impact device calibration** is for the import of the calibration values. Every time, when you buy a new impact device or an impact device was sent for calibration to our technical service, the calibration value will be delivered on a USB flash drive. For transferring the calibration to the dynoROCK II the flash drive has to be plugged in and the menu item **System / Impact device calibration** has to be selected.

### 9.6 Factory defaults

With the aid of the menu item **System / Factory defaults**, the current measuring parameters and the date format can be reset to the default values.

### 9.7 System information

Under the menu item **System / Info**, the system information is displayed. The version numbers of the software, the kernel and the system are included here. If a impact device is connected, the impact device is also displayed

## 10 Elimination of faults

If the device should no longer react by pressing a key, the device can be switched off by long pressing of the On-Off switch.

## 11 Care and maintenance

### 11.1 Impact device

The impact device should be cleaned with the delivered cleaning brush after 1000 to 2000 measurements. For this purpose, the placement ring is screwed off, the impact body removed and the brush inserted into the guide tube rotating anti-clockwise approx. five times to the end stop, and pulled out again. After that, the impact body is again installed and the placement ring screwed on.

- After use of the impact device, the spring should be decompressed.
- No lubricants may be employed when cleaning the impact device!

### 11.2 Maintenance

If the measuring error of the device is greater than 2 HRC in case of measurements on the hardness comparison block supplied, the impact body or the test tip may possibly have to be replaced.

In case of all other functional disturbances, the device must be sent to the technical service. Replacement services cannot be made in case of repairs carried out by yourself.

## 12 Safeguarding and transport

The test device should be kept at room temperature and protected against vibrations, strong magnetic fields, corrosive materials, moisture and dust.

The original packing should be used for the transport of the device.

## 13 Information on waste disposal



Verbraucher sind gesetzlich verpflichtet Altbatterien zu einer geeigneten Sammelstelle/Verkaufsstelle/Versandlager zu bringen. Die durchgestrichene Mülltonne bedeutet: Batterien und Akkus dürfen nicht in den Hausmüll. Pb, Cd und Hg bezeichnet Inhaltsstoffe die oberhalb der gesetzlichen Werte liegen.

### 13.1 English

Consumers are legally required to dispose of batteries at suitable collection points, vending points or dispatch bays. The crossed-out wheeled bin means that batteries must not be disposed of in the household waste. Pb, Cd and Hg designate substances that exceed the legal limits.

### 13.2 Français

La législation exige des consommateurs le dépôt des piles usagées dans un lieu de collecte approprié, un point de vente ou un entrepôt d'expédition. La poubelle barrée signifie qu'il est interdit de jeter les piles et les batteries avec les ordures ménagères. Pb, Cd et Hg désignent les substances dont les valeurs dépassent les limites légales.

### 13.3 Italiano

Per legge, i consumatori sono obbligati a depositare le batterie esaurite presso i punti di raccolta, i punti di vendita o i magazzini di spedizioni. Il simbolo del contenitore dei rifiuti sbarrato indica che è vietato smaltire le batterie con i rifiuti domestici. Pb, Cd e Hg indicano le sostanze presenti con valori superiori alla norma.

### 13.4 Español

Los usuarios están obligados por ley a depositar las pilas viejas en un punto de recogida adecuado /punto de venta/centro de envío. El contenedor de basura tachado significa: la pilas no deben desecharse en la basura doméstica. Pb, Cd y Hg designan sustancias que se encuentran por encima de los valores establecidos por ley.

## 14 Technical data

<b>Measurement range</b>	170 HLD to 960 HLD		
<b>Impact direction</b>	360°		
<b>Hardness scale</b>	HL, HB, HRB, HRC, HV, HS and tensile strength		
<b>Statistics</b>	average value, minimum, maximum, standard deviation. Outliers can be deleted.		
<b>Display</b>	LCD 320x240 pixels, 65536 colors		
<b>Data memory</b>	500,000 data records with date, time and GOOD/BAD rating and impact direction		
<b>Power supply</b>	Integrated rechargeable lithium-ion battery. Charging over charging adapters or over PC-USB		
<b>Operating time</b>	approx. 16 h. Charging time with charging adapters approx. 3 h. Charging time over PC-USB approx. 6 h.		
<b>USB interface</b>			
<b>Temperatures</b>	in operation 10°C to 40°C; storage -10°C to 60°C		
<b>Dimensions</b>	Height	22	mm
	Width	79	mm
	Depth	135	mm
<b>Weight</b>	425 g incl. impact device D and cable		

The precision and reproducibility of the measured values is represented in 2

TECHNICAL DATA

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No.	Impact device type	Hardness of the Leeb hardness comparison block	Fault of the measured value	Repeatability
1	D	760 ±30 HLD 530 ±40 HLD	±6 HLD ±10 HLD	6 HLD 10 HLD
2	DC	760 ±30 HLDC 530 ±40 HLDC	±6 HLDC ±6 HLDC	6 HLD 10HLD
3	DL	878 ±30 HLDL 736 ±40 HLDL	±12 HLDL	12 HLDL
4	D+15	766 ±30 HLD+15 544 ±40 HLD+15	±12 HLD+15	12 HLD+15
5	G	590 ±40 HLG 500 ±40 HLG	±12 HLG	12 HLG
6	C	822 ±30 HLC 590 ±40 HLC	±12 HLC	12 HLC

Table 2

## 15 Appendix

Material	Hardness scale	Impact device				
		D / DC	D+15	C	G	DL
Steel and cast steel	HRC	20,0 – 68,4	20,0 – 68,4	20,0 – 68,4		20,0 – 68,4
	HRB	38,4 – 99,5	38,4 – 99,5	38,4 – 99,5	47,7 – 99,9	38,4 – 99,5
	HB	81 – 654	81 – 654	81 – 654	90 – 646	81 – 654
	HV	81 – 955	81 – 955	81 – 955		81 – 955
	HS	29,7 – 99,5	29,7 – 99,5	29,7 – 99,5		29,7 – 99,5
	MPa / N/mm <sup>2</sup>	258-2180			304-1551	
Tempering steel, heat treated	HRC	20,0 – 68,4				
	HRB	38,4 – 99,5			47,7 – 99,9	
	HB	81 – 654			90 – 646	
	HV	81 – 955				
	HS	29,7 – 99,5				
	MPa / N/mm <sup>2</sup>	654-1454			651-1436	
Tempering steel, annealed	HRC	20,0 – 68,4				
	HRB	38,4 – 99,5			47,7 – 99,9	
	HB	81 – 654			90 – 646	
	HV	81 – 955				
	HS	29,7 – 99,5				
	MPa / N/mm <sup>2</sup>	460-826			503-823	
Tempering steel, hardened	HRC	20,0 – 68,4				
	HRB	38,4 – 99,5			47,7 – 99,9	
	HB	81 – 654			90 – 646	
	HV	81 – 955				
	HS	29,7 – 99,5				
Cold work tool steel	HRC	20,4 – 67,1	20,4 – 67,1	20,4 – 67,1		
	HV	80 – 898	80 – 898	80 – 898		
Stainless steel	HRB	46,5 – 101,7				
	HB	85 – 655				
	HV	85 – 802				
Grey cast iron	HB	93 – 334			92 – 326	
Nodular cast iron	HB	131 – 387			127 – 364	
Cast aluminum alloys	HB	19 – 164		23 – 210	32 – 168	
	HRB	23,8 – 84,6		22,7 – 85,0	23,8 – 85,5	
Brass (copper-zinc alloys)	HB	40 – 173				
	HRB	13,5 – 95,3				

## APPENDIX

Bronze (copper- aluminum / copper-tin alloys)	HB	60 – 290				
Wrought copper alloys	HB	45 – 315				

*Table 3*

<b>Impact device type</b>	<b>DC/D/DL</b>	<b>D+15</b>	<b>C</b>	<b>G</b>
Impact energy	11 mJ	11 mJ	2.7 mJ	90 mJ
Weight of the impact body	5.5 g /DL: 7.2 g	7.8 g	3.0 g	20.0 g
Hardness of the test tip	1600 HV	1600 HV	1600 HV	1600 HV
Diameter of the test tip	3 mm	3 mm	3 mm	5 mm
Material of the test tip	Tungsten carbide	Tungsten carbide	Tungsten carbide	Tungsten carbide
Diameter of the impact device	20 mm	20 mm	20 mm	30 mm
Length of the impact device	86(147)/75 mm	162 mm	141 mm	254 mm
Weight of the impact device	50 g	80 g	75 g	250 g
Maximum sample hardness	940 HV	940 HV	1000 HV	650 HB

*Table 4 Properties of the impact devices*

<b>Impact device type</b>	<b>DC/D/DL</b>	<b>D+15</b>	<b>C</b>	<b>G</b>
Surface Roughness Ra / Rt ISO Class	2 $\mu$ m/10 $\mu$ m N7	2 $\mu$ m/10 $\mu$ m N7	0.4 $\mu$ m / 2.5 $\mu$ m N5	7 $\mu$ m / 30 $\mu$ m N9
Minimum weight of the sample				
For direct measurement	> 5 kg	> 5 kg	> 1.5 kg	> 15 kg
On stable underlay	2 - 5 kg	2 - 5 kg	0.5 - 1.5 kg	5 - 15 kg
Minimum thickness of the surface hardening	$\geq$ 0.8 mm	$\geq$ 0.8 mm	$\geq$ 0.2 mm	

*Table 5 Requirements on the sample*

	<b>D / DC / DL</b>	<b>D+15</b>	<b>C</b>	<b>G</b>
<b>At 300 HV, 30 HRC Diameter/Depth</b>	0.54mm/24 $\mu$ m	0.54mm/24 $\mu$ m	0.38mm/12 $\mu$ m	1.03mm/53 $\mu$ m
<b>At 600 HV, 55 HRC Diameter/Depth</b>	0.45mm/17 $\mu$ m	0.45mm/17 $\mu$ m	0.32mm/8 $\mu$ m	0.90mm/41 $\mu$ m
<b>At 800 HV, 63 HRC Diameter/Depth</b>	0.35mm/10 $\mu$ m	0.35mm/10 $\mu$ m	0.30mm/7 $\mu$ m	

*Table 6 Size of the impressions in case of different hardening and impact devices*

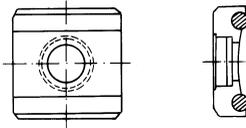
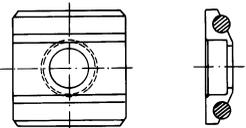
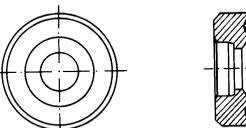
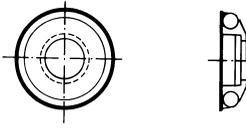
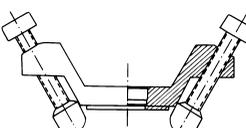
No.	Type	Sketch of the placement ring	Remarks
1	Z10-15		For convex surfaces R10 – R15
2	Z14.5-30		For convex surfaces R14.5 – R30
3	Z25-50		For convex surfaces R25 – R50
4	HZ11-13		For concave surfaces R11 – R13
5	HZ12.5-17		For concave surfaces R12.5 – R17
6	HZ16.5-30		For concave surfaces R16.5 – R30
7	K10-15		For spheres SR10 – SR 15
8	K14.5-30		For spheres SR14.5 – SR 30
9	HK11-13		For hollow bodies SR11 to SR13
10	HK12.5-17		For hollow bodies SR12.5 to SR17
11	HK16.5-30		For hollow bodies SR16.5 to SR30
12	UN		For convex surfaces, Radius adjustable R10 - $\infty$

Table 7

A complete set of placement rings is available as an option.

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- 2) Crc16.c

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