# dynaROCK III


**User Manual**

Version 1.1

BAQ

## Manufacturer’s Address

BAQ GmbH

Hermann-Schlichting-Str. 14

D-38110 Braunschweig

Tel.: +49 5307 / 95102 - 0

Fax: +49 5307 / 95102 - 20

Mail: info@baq.de

**Made in Germany**

# Copyright

# *Table of Contents*

# 1 Safety and Liability

## 1.1 Introduction

This manual contains important information and safety instructions required for trouble-free and safe operation of the dynaROCK III. It must be submitted to every user involved with installation, operation, maintenance and repair of the equipment and has to remain permanently accessible in its surroundings. Persons unable to understand or to follow the instructions provided are not allowed to work with the instrument.

In the case of suggestions concerning this document or supplementary questions, do not hesitate and contact our service team (service@baq.de).

## 1.2 Safety Notes

- Before starting any activity, carefully read this manual.
- Access to the document must always be ensured.
- Messages and warnings displayed on the dynaROCK III should not be ignored.
- Operation in electrically hazardous or explosive environment is not admitted.
- Never leave the equipment to persons unable to follow safety instructions.
- Assign qualified supervision for new personnel.
- The dynaROCK III is a sensitive device and should not be subjected to mechanical risks like shocks or strong vibrations.
- Before starting to clean the equipment, switch it OFF and disconnect the USB cable.
- Regular maintenance should not be omitted and is reserved to qualified personnel (i.e. tasks concerning electrical components should only be performed by an electrician).
- After completion of maintenance, do not forget to perform functional control.
- Damaged or worn cables should immediately be replaced.
- As soon as a critical damage (e.g. concerning the isolation) becomes obvious, switch OFF the instrument, disconnect the USB cable and consult factory service.
- The instrument must be protected from contact with liquid and humidity.
- Be aware that magnetic components in the vicinity may impair the precision of the measurement.

## 1.3 Liability

The instrument has been developed and manufactured according to the latest technological standards and current safety directives and has left the site in perfect condition. The client bears the entire responsibility for adequate use and operation by appropriate personnel. Note that warranty and liability claims relating to injuries or material damage, arising from one or several of the following reasons, shall be rejected:

- Applications beyond the scope described in the manual.
- Failure to observe safety information, with respect to operation, maintenance, cleaning and functional control of the instrument itself or connected accessories.
- Arbitrary modification of the instrument or connected accessories. In case of doubt, always consult factory service beforehand!
- Exchange of components by items not released by the manufacturer. Original BAQ spare parts are prescribed.
- Use of accessories not recommended by the manufacturer.
- Damage caused by accidents, improper handling or force majeure.

The information has been compiled by the manufacturer at the best of his knowledge, but no responsibility for correctness, completeness and accuracy can be assumed. In any case of doubt, consult factory service in time.

## 1.4 Appropriate Use

The instrument, developed exclusively for measurement of hardness for metal objects in solid state, should always be used in conformity with instructions specified in this document. Never leave it to unauthorized personnel, and interrupt all activities whenever a damage is suspected. Any application beyond the specification is considered as improper use.

# 2 Scope of Delivery

Scope of Delivery:

1 Basic unit dynaROCK III
2 Impact device type D
3 Probe cable dynaROCK III ↔ Impact device
4 Power supply (100-240 VAC; 50/60 Hz; 1.5 A)
5 USB cable (USB-A ↔ USB-C)
6 USB-Stick with manuals (PDF)
7 Transport case
8 Adjustable strap
9 Adapter USB-A ↔ USB-C
10 Leeb test block
11 Cleaning brush
12 BAQ ISO certificate

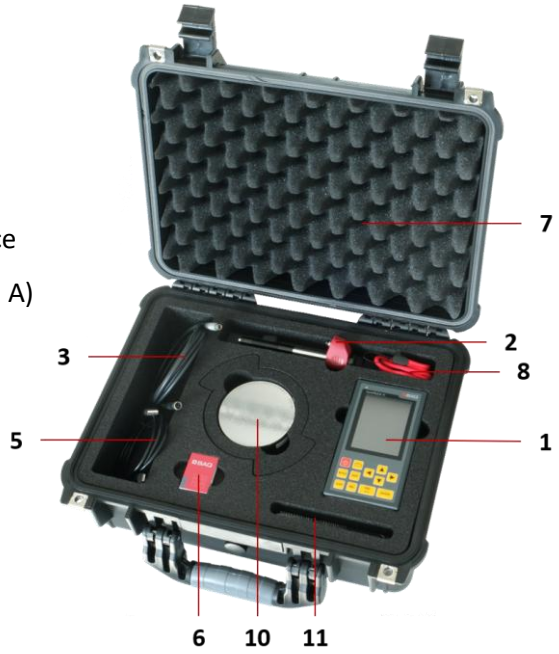



*Fig. 1: Case with content (Pos. 4, 9, 12 not visible)*

Options available upon request:

a1 Supplementary Leeb impact devices (refer to Fig. 3)
a2 DAkkS certified Leeb test blocks (ISO and ASTM)
a3 Prism attachments for measurements on curved surfaces
a4 Mobile printer

> *i* All articles incl. order codes are listed in Appendix 2: Order information.

# 3 Specification

*Table 1: Specification dynaROCK III*

| | | | |
|---|---|---|---|
| ***Dimensions*** | 154 x 84 x 23 mm (H x W x D) | | |
| ***Weight*** | 430 g | | |
| ***Display*** | 3.5“-TFT-LCD color display<br>640 x 480 Pixel | | |
| ***Battery pack*** | Integrated Lithium-Ion-Battery, 6800 mAh | | |
| ***Operating time*** | approx. 12 h | | |
| ***Charge time*** | approx. 4 h (from 10 to 80 % in disabled state) | | |
| ***Memory*** | 2 GB RAM, 32 GB eMMC-Flash-Memory | | |
| ***Temperature ranges*** | Storage: | -20°C to 70 °C | -4°F to 158 °F |
| | Operation: | -15°C to 60 °C | 5°F to 140 °F |
| | Charging: | 0°C to 40 °C | 32°F to 104 °F |
| ***Humidity*** | 90 % max., non-condensing | | |
| ***Environment*** | Suitable also for outdoor applications | | |
| ***Connectors*** | USB-C (charging and data transfer)<br>Socket for probe cable | | |
| ***Signal devices*** | Status-LED<br>Beeper | | |
| ***Languages*** | German, English | | |
| ***Testing method*** | Leeb hardness acc. to DIN EN ISO 16859, ASTM A956 and VDI/VDE directives 2616, sheet 1 | | |
| ***Admitted material*** | Preferably metals belonging to material groups stored in the dynaROCK III | | |

*Table 2: Specification of impact devices*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ***Indenter*** | Carbide ball acc. to DIN EN ISO 16859 and ASTM A956 | | | | | | |
| ***Impact devices*** | **Type** | **D** | **DL** | **D+15** | **DC** | **C** | **G** |
| | Impact speed [m/s] | 2.05 | 2.05 | 2.05 | 2.05 | 1.39 | 2.98 |
| | Mass of impactor [g] | 5.45 | 7.25 | 7.75 | 5.45 | 3.1 | 20.0 |
| | Ø Test tip [mm] | 3 | 3 | 3 | 3 | 3 | 5 |
| | Ø Support ring [mm] | 20 | - | 14 | 20 | 20 | 30 |
| | Length [mm] | 147 | 75 | 162 | 86 | 141 | 254 |
| | Weight [g] | 50 | 50 | 80 | 50 | 75 | 250 |
| ***Measuring ranges*** | Refer to Appendix 1: Conversion ranges | | | | | | |
| ***Resolution*** | 1 HL | | | | | | |
| ***Testing direction*** | Adjustable | | | | | | |
| ***Hardness scales*** | HL, HV, HB, HRC, HRB, HRA, N/mm² (depending on impact device) | | | | | | |

*Table 3: Accuracy and repeatability dynaROCK III in accordance with DIN EN ISO 16859-2*

| ***Impact device type*** | ***Hardness of the Leeb test block [HL]*** | ***Max. Error of the test device [%]*** | ***Acceptable coefficient of variation of the test device*** |
|---|---|---|---|
| **D, DC, D+15** | < 500 | ± 4,0 | 2,5 |
| | 500 – 700 | ± 3,0 | 2,0 |
| | > 700 | ± 2,0 | 1,5 |
| **DL** | < 700 | ± 4,0 | 2,5 |
| | 700 – 850 | ± 3,0 | 2,0 |
| | > 850 | ± 2,0 | 1,5 |
| **G** | < 450 | ± 4,0 | 2,5 |
| | 450 – 600 | ± 3,0 | 2,0 |
| | > 600 | ± 2,0 | 1,5 |
| **C** | < 600 | ± 4,0 | 2,5 |
| | 600 – 750 | ± 3,0 | 2,0 |
| | > 750 | ± 2,0 | 1,5 |

# 4 Introduction to the Hardness Testing Method acc. to Leeb

## 4.1 Measuring Principle

This hardness testing method invented by Dietmar Leeb evaluates the difference between impact speed and rebound speed of a small impact body, which is shot to the sample surface by the impact device at a precisely defined energy. As the plastic deformation of the surface consumes a certain amount of energy, the speed of the impact body during rebound becomes lowered. Both speed values are inductively measured 1 mm above the surface. The hardness value HL (hardness acc. to Leeb) is defined as the relation between rebound speed $v_R$ and impact speed $v_A$, multiplied by factor 1000. The HL parameter is accompanied by a third or sometimes fourth letter specifying the type of impact device (impact device D → HLD).

$$HL = \frac{v_R}{v_A} * 1000$$

with: HL: Leeb Hardness
$v_R$: Rebound speed
$v_A$: Impact speed

As for a softer material the indentation is increased, the amount of consumed energy is higher, and the rebound speed is lower compared to a test on a hard material. For this reason, the calculated hardness result is lower as well. Note that the influence of gravity must be taken into consideration, so the dynaROCK III enables the impact direction to be adjusted, to compensate for possible errors.

HL hardness results are dimensionless. It is important to know that they do not only depend on the hardness, but also on other properties of the material under test. On the basis of empirically determined conversion tables, HL results can be transformed to conventional hardness scales. For many material groups, conversions are stored in the dynaROCK III, taking these properties into account. Within a particular material group however, the variation of properties can be neglected, as the hardness results remain unaffected.

As the hardness result for this dynamic measurement is determined directly after creation of the indentation, it proves to be very quick, thus perfectly suited for mobile applications.

## 4.2 Main Applications

The dynaROCK III is a mobile hardness testing instrument making use of the Leeb method. It is intended for metals. Main applications include:

- Incoming inspection
- Quality control during running production
- Mobile inspection of components directly “in the field“
- Tests in any orientation
- Positions with difficult access, narrow spaces or in presence of complex part geometry
- Inspection of heavy objects or parts difficult to move
- Tests to be carried out within shortest delay

These applications clearly illustrate the versatility and the significance of the method in numerous industrial sectors. Reliable and exact results considerably enhance the possibilities in quality control, failure analysis and material characterization.

## 4.3 Requirements for the application of the Leeb procedure

To ensure efficient and precise hardness testing by means of the dynaROCK III, observe the following conditions:

### 4.3.1 Qualification of Personnel

Sufficient knowledge and experience of the testing personnel is decisive, both with respect to hardness testing in general and particular features of the Leeb method itself, as follows:

- Knowledge of the influence of material properties like microstructure and modulus of elasticity, in order to select and to implement a convenient testing method
- Knowledge of the effect of the surface structure on the detected hardness value
- Understanding of the conversion HL hardness results into other scales, as well as an overview concerning the different methods of hardness measurement
- Practical experience in handling of impact devices

### 4.3.2 Requirements to the Sample

Even though the Leeb method is convenient for nearly all metallic materials, the properties of the sample itself should not be disregarded when interpreting a result. This circumstance, by the way, holds for every hardness testing method.

In this context, besides the surface structure, the sample thickness and weight as well as its homogeneity have to be mentioned. Strong scattering of results or major deviations may be caused by excessive roughness or insufficient sample thickness or weight. For this reason, before initiating a test, verify the suitability of the sample and prepare it conveniently in case of need. During preparation do not make use of procedures which in the following could affect the surface hardness (e.g. caused by overheating).

To ensure a reliable and reproducible test, the sample must fulfill the following requirements:

*Table 4: Conditions for a sample to perform a Leeb hardness test*

| ***Type of impact device*** | **D / DC / DL / D+15** | **C** | **G** |
|---|---|---|---|
| ***Max. surface roughness $R_a$/$R_t$*** | 2 µm / 10 µm | 0.4 µm / 2.5 µm | 7 µm / 30 µm |
| ***Roughness class ISO 1302*** | N7 | N5 | N9 |
| ***Min. weight (without firm support)*** | > 5 kg | > 1.5 kg | > 15 kg |
| ***Min. weight (with firm support)*** | > 2 kg | > 0.5 kg | > 5 kg |
| ***Min. thickness (without coupling)*** | 25 mm | 10 mm | 70 mm |
| ***Min. thickness (with coupling)*** | 3 mm | 1 mm | 10 mm |
| ***Min. thickness of surface hardening*** | ≥ 0.8 mm | ≥ 0.2 mm | - |
| ***Min. distance to border*** | 5 mm | 5 mm | 10 mm |
| ***Min. distance between two indentations*** | at least 3 x indentation diameter | | |
| ***Test environment*** | During the test, the sample should neither move nor be subjected to vibrations. Environmental influences like temperature and humidity must be taken into consideration, too. | | |
| ***Surface*** | Even and shiny metallic. Cleanliness and absence of oxides, grease and foreign matter are imperative. (Treatment with abrasive paper or isopropyl alcohol may be necessary). | | |

If the maximum roughness depths specified in Table 4 are exceeded, the sample surface may be prepared e.g. by means of abrasive paper. Partial whetting of the test point is sufficient.

Support for samples

- No support is required for heavy items (refer to Table 4).
- Medium weight specimens however need a flat, massive support (refer to Table 4).
- Place the sample on the support in a stable and levelled manner.
- During the test, the sample should neither move nor be subjected to vibrations.

Sample geometry

Even though the sample matches the requirements specified in Table 4, the impact in the case of large plates, long rods or bent items may give rise to smaller deviations or vibrations which affect the measuring precision. In corresponding situations, it is advisable to reinforce or to support the opposite side of the test point. Note that it is always advantageous to select a sample of compact shape or a measuring position in the surroundings of the mass concentration of the sample.

Bending radii

If no flat sample surface is available, surfaces with a bending radius of R < 30 mm (for impact devices type D, DC, D+15 and C) are possible, but they require the presence of a corresponding shaped support ring screwed on beforehand, so that the impact device can be safely positioned.

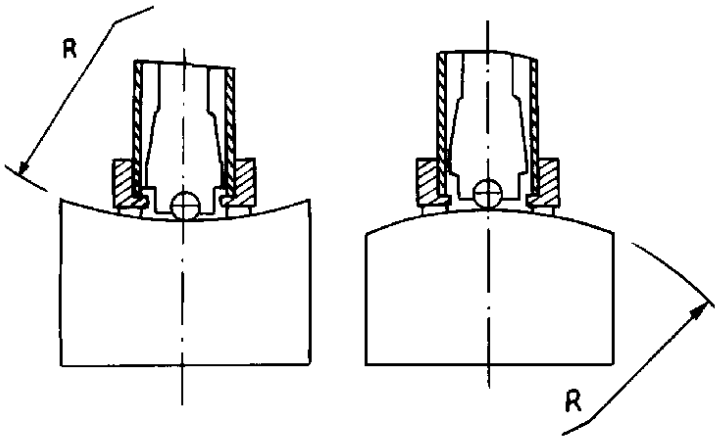



*Fig. 2: Test on bent surfaces*

Hardness test on coatings

As the Leeb method cannot manage without a certain penetration depth (refer to Table 5), it is not convenient for very thin coatings. The minimum thickness required for surface hardening is specified in Table 4.

Self-magnetism

Self-magnetism of the sample is not admissible, as the speed of the impactor may be influenced.

Homogeneity

Local variations of material properties like elastic modulus may have an effect on the result. Sufficient homogeneity of the material therefore is essential, in order to carry out a meaningful test. Furthermore, it is imperative that the size of the impression considerably exceeds the grain size.

### 4.3.3 Regular Functional Control

Combined with the impact devices, the dynaROCK III offers - if correctly used - a stable system with a long lifetime. Nevertheless, regular inspections are strongly recommended. This includes:

- Visual inspection of the impact body under a microscope.
- Visual check of connecting cable, plug connections, support ring and impact device.
- Verification of accuracy and repeatability, on hardness test blocks acc. to standard DIN EN ISO 16859 or ASTM A956. The detected HL reading should not fall beyond the specified tolerances of the engraved value.
- Regular maintenance incl. calibration (annual interval recommended), performed by BAQ GmbH or authorized factory service, is helpful to ensure accuracy of the results over the entire hardness range acc. to relevant standards.

DIN EN ISO 16859-1 specifies in detail the periodic verification of Leeb hardness testing equipment by users. Prior to start-up, at least three measurements on an appropriate hardness test block (i.e. a test block with similar expected hardness) are recommended. The following conditions must be met:

1. Difference between average and engraved hardness value of the test block ≤ 5 %.
2. Max. span ≤ 5 %.

In the case of excessive deviation, first check:

- Has the correct test block been used? The surface must be clean and dry, no vibrations are admissible. If the test block has been used already for a long time, it may show too many impressions so the minimum distance between them is no more available. Exchange the item.
- Check and clean impact device and impact body (refer to chapter 8).
- Do not forget to set the material corresponding to the test block and to use the correct hardness scale.

! Often Vickers or Rockwall hardness test blocks are used for mistake, but they are intended for stationary hardness testing machines. Mass and thickness of these items are far too low for Leeb hardness tests (refer to Table 4).

*i* With increasing number of tests on hardened components, the carbide ball in the impact body becomes flattened and must be exchanged – otherwise no more accurate results can be expected.

*i* As soon as the results do not meet the requirements described above anymore, return the equipment to BAQ for calibration.

## 4.4 Selection of Impact Devices

In addition to impact device type D already included in the standard delivery, various models for hardness tests acc. to Leeb are available, meeting the needs in different applications. They are illustrated in Fig. 3 and detailed in the following:

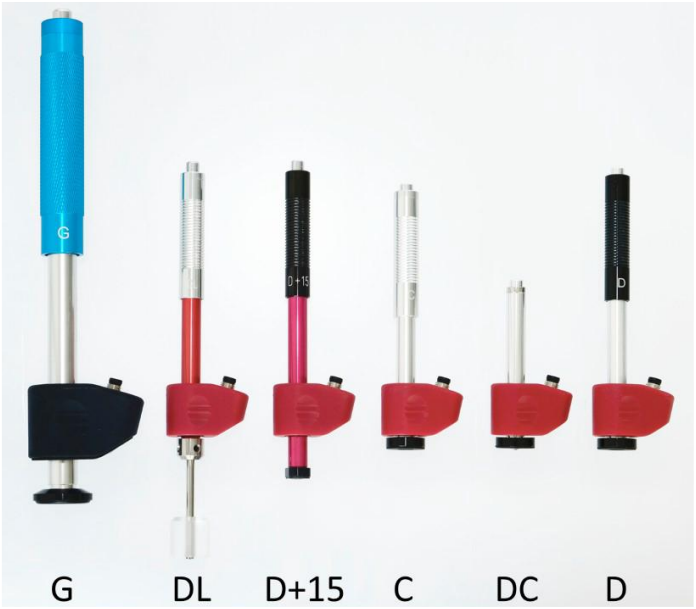



*Fig. 3: Impact devices for hardness tests acc. to Leeb*

**Type D:** Standard device, covering most of usual test purposes.

**Type DC:** Extremely short model, practical for positions with difficult access or in tubes.

**Type C:** For this type, the impact energy is reduced, which proves to be useful for surface hardened objects. Its impression size amounts only to the half of type D impressions, but the requirements to surface quality are higher.

**Type D+15:** Intended for measurements within grooves and recesses, this device disposes of a coil relocated by 20 mm and a smaller support area (11 mm x 14 mm instead of Ø20 mm, so grooves with a depth of up to 20 mm and a width of 11 mm can inspected).

**Type DL:** This item features an extended impact body. The diameter of the front tube amounts to 4.2 mm.

**Type G:** Heavy castings and forgings and castings require a higher impact energy. The requirements to surface -compared to measurements by type D- are reduced.

The different impact devices are equipped partially with different impact bodies, which consequently entail different impact energy and indentation size. The following table shows a selection of indentation diameters and depths for three sample hardness results, depending of the impact device in use.

*Table 5: Size of impressions for different hardness results and impact devices*

| ***Hardness*** | ***D / DC / DL / D+15*** | | ***C*** | | ***G*** | |
|---|---|---|---|---|---|---|
| | ***Ø*** | ***Depth*** | ***Ø*** | ***Depth*** | ***Ø*** | ***Depth*** |
| 300 HV / 30 HRC | 0.54 | 24 | 0.38 | 12 | 1.03 | 53 |
| 600 HV / 55 HRC | 0.45 | 17 | 0.32 | 8 | 0.90 | 41 |
| 800 HV / 63 HRC | 0.35 | 10 | 0.30 | 7 | - | - |

According to the impact device, the HL result (which serves as reference and can be calculated anytime) can be converted into other hardness scales (e.g. HRC). In Appendix 1: Conversion ranges available hardness scales with their conversion ranges are specified for all materials and all impact devices.

## 4.5 Applicable Standards

The Leeb hardness test is defined in national and international standards, together with requirements to testing equipment and measurement procedure. Complying with these standards ensures an accurate hardness measurement with reliable results:

- DIN EN ISO 16859 Leeb Hardness Tests
- ASTM A956 Leeb Hardness Testing on Steel Products

# 5 Operation

The following chapter describes structure and practical handling of the Leeb hardness testing instrument dynaROCK III.

## 5.1 Design and Connections


*Fig. 4: Structure, operating elements and connections*

*Table 6: Connections and operating elements*

| ***No.*** | ***Designation*** | ***Description*** |
|---|---|---|
| 1 | Status-LED | Lights up with reduced brightness if the dynaROCK III is being charged when switched OFF.<br>After switching ON, this element is lit permanently. |
| 2 | USB-C | Interface for charging and data transfer to PC or USB stick. |
| 3 | Socket for connection of Impact devices | Attachment of probe cable, with Push-Pull lock. |
| 4 | Display | 3.5“-TFT-LCD color display. |
| 5 | Keyboard | The instrument is controlled by these buttons. |
| 6 | Fixing hole | Intended for strap. |

## 5.2 Charging, Switching ON and OFF

Prior to initial use, charge the instrument completely by means of the power pack included in the delivery, first establishing a mutual connection via USB-cable provided. As soon as this connection exists, plug in the power pack into a power socket (for some countries, an adapter may be required). If the instrument is switched ON however, charging process becomes visible by a flash in the battery symbol within the status line. If the dynaROCK III is being charged when it is switched OFF, the status LED lights up with reduced brightness.

> *i* The charging process from 10 to 80 % takes approx. 4 hours.

> *i* If the connector is plugged in too slowly, the charging process takes place at reduced speed for safety reasons, since the power management of the instrument within the default time limit cannot identify USB-cable and power module as safe.

The dynaROCK III is switched ON and OFF by POWER button. After activation, the Status-LED is continuously lit. When the instrument is ready to operate, the screen shows either the main menu (if no impact device is connected) or instantaneously the Measurement window with the last settings (with impact device connected).

## 5.3 General Operation

Status Line

The status line always appears in the upper zone of the display, showing time and charge level of the battery. According to the charging state of the battery, one of the following symbols is indicated:


The charging process is running


Battery level sufficient


Low level

Text Input

Saving measuring data or parameters requires text input. In these situations, a text input window is opened, e.g. when entering a name for a series measurement (see Fig. 5).


*Fig. 5: Text input dialog*

The current text (here: Crankshaft SN 1297) is shown in the corresponding field, selectable characters appear below. The buttons shown in the lower area have the following functions:

| | |
|---|---|
| A/a | Switch over between upper and lower case |
| OK | Accept the text and close text input window |
| ⌫ | Delete last character |
| CANCEL | Close text input window, discarding the changes made |

Important key functions during text entry:

| | |
|---|---|
| DEL: | Delete last character |
| ESC: | Close text input window, discarding the changes made |
| ⇥: | Change between text field, symbol table and buttons |

Number Input

For input of numbers, corresponding fields are provided. Digits in these fields can be changed individually, by moving the cursor to the desired position by ◄ and ►. The active position is marked, and the corresponding value can be increased or lowered by ▲ and ▼. A further position can be added in leading position by ◄ cursor (to obtain larger values). Examples of number input fields are the entries of Upper tolerance limit, Lower tolerance limit and Number for statistics in the measurement parameter dialog, see Fig. 6.

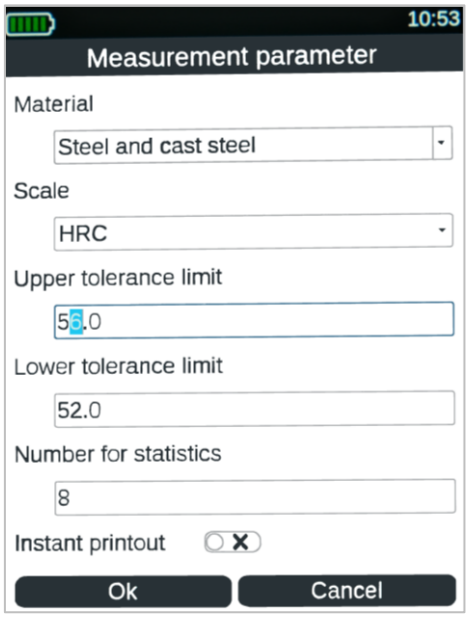



*Fig. 6: Fields for number input*

Important key functions during entry of numbers:

| | |
|---|---|
| DEL: | Set back number input |
| ⇥: | The entry is accepted, and the next field becomes activated |

Selection Dialogs

There are selection dialogs at various points in the dynaROCK III, e.g. if a series or serial series is to be continued, deleted, displayed or transferred to a USB stick. Fig. 7 shows the selection of a series of a serial series as an example.

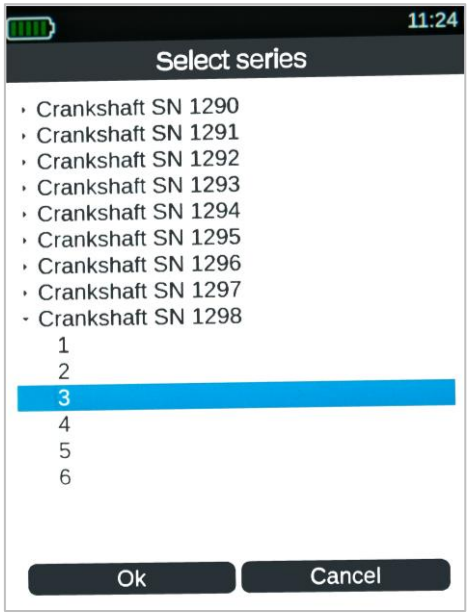



*Fig. 7: Selection Dialog*

In these dialogs, the desired data set is chosen by arrow keys. To select OK button, press ⏭. The corresponding action is finally put into effect by pressing ENTER.

## 5.4 Preparation and Basic Settings for Leeb Hardness Test

**Connection of the impact device**

Impact devices are connected via probe cable included in the delivery. To avoid faulty connection, insertion has to be carried out always in specified orientation.

The connections feature Push-Pull locks, reliably protecting from detachment and insensitive to vibrations, so the connection during operation remains stable. To disconnect, axially draw the outer sleeve of the plug.

> *i* Impact devices can also be attached or changed, while the instrument is switched ON.

**Preparation**

Before initiating the actual measurement, use a suitable Leeb hardness test block to check functionality. Daily verification is recommended. Furthermore, it is essential that the sample is appropriate for Leeb-testing. If required, the sample has to be prepared according to instructions in chapter 4.3.2.

**Adjustment of Measurement Parameters**

Measurement parameters may have to be adjusted, whereas the type of the connected impact device is recognized automatically, not influenced by the user. Open the dialog for parameters either by menu point **Measurement parameter / Edit** or by means of the Settings buttons within the Measurement window. Generally, the parameters shown in Fig. 8 are provided. They are described in the following.

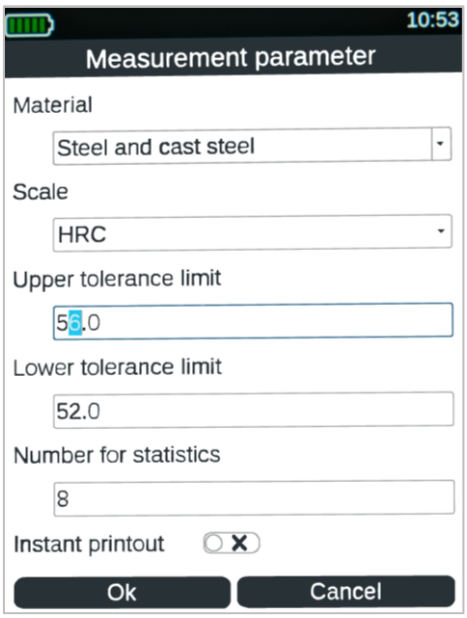



*Fig. 8: Adjustment of measurement parameters*

> After switching ON, initially always the last used measurement parameters are active. Measurement parameters material, hardness scale and tolerance limits can directly be set in the Measurement window.

> For frequently arising measuring tasks, it is favorable to store measurement parameter sets; retrieve them whenever needed (refer to chapter 5.6).

**Material**

This field shows the current material group. Within the Measurement window, it can be changed by MAT key.

**Hardness Scale**

The results are displayed by means of the specified scale, with the Leeb hardness serving as reference scale. After selection of another scale, the results are transformed, if possible (refer to Appendix 1: Conversion ranges). To changeover to another scale, press SCALE key in the Measurement window.

> *i* Hardness values that cannot be converted to the new hardness scale are displayed as 0.

**Upper/Lower tolerance Limits**

This function defines the tolerance range, to set up a distinction between OK and NOK results. Upper and/or lower limits can be specified. If "-" is entered for a particular limit, this limit is left aside.

Results beyond the tolerance range are marked in red, and a beeper alarm sounds (two short signals). An arrow shows whether the value is excessive or insufficient. Acceptable results are displayed in green, accompanied by a single acoustic signal.

Note that limits are stored only for one hardness scale. If limits are entered for another scale, existing input is overwritten.

**Number for Statistics**

This quantity describes the population, i.e. the number (n) of measurements to be included in statistical analysis. As soon as the value (n) is reached, the Statistics window opens automatically (refer to chapter 5.5.2). This function correspondingly offers an intermediate information within a series. If intermediate statistical analysis is deemed to be unnecessary, set this value to 0.

**Instant Printout**

If a mobile printer is connected, the feature of logging measuring results line-by-line, can be switched ON and OFF by means of this selector switch. If no printer is connected to the dynaROCK III, the function is not available.

> *i* If instant printout is activated, deleting measuring results is no more possible.

**Impact device type**

As already mentioned, the type of the impact device is a parameter directly transmitted from the impact device to the instrument and cannot be altered by the user.

## 5.5 Measurement Window

### 5.5.1 Overview and Settings

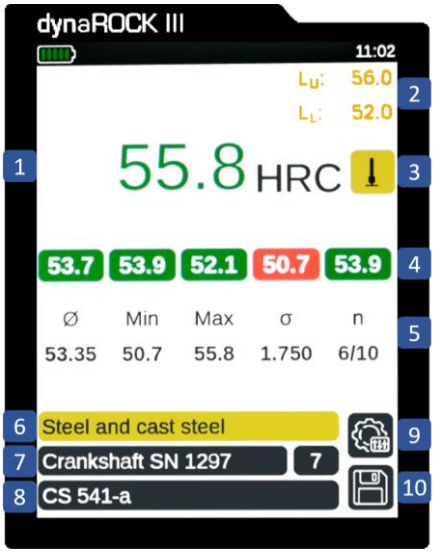



*Fig. 9: Measurement window*

*Table 7: Measurement window*

| ***No.*** | ***Designation*** | ***Description*** |
|---|---|---|
| 1 | Hardness Value and Scale | Last result with assigned hardness scale. |
| 2 | Limits | Individually specified tolerance limits. |
| 3 | Impact direction | Selected impact direction (0°, 45°, 90°, 135°, 180°) |
| 4 | Result History | The last five results are displayed. |
| 5 | Statistics | Statistical analysis of the active series with average (Ø), minimum/maximum (Min/Max), standard deviation (σ), number of measurements (n; deleted measurements are not included). |
| 6 | Material | Material group currently in use. |
| 7 | Name and No. of series/ serial series | Designation of user defined series or serial series (if loaded) and No. of the series within the serial series. |
| 8 | Name of measurement parameter set | Designation of a user defined measurement parameter set (if loaded). |
| 9 | Settings | Adjustment of measurement parameters (refer to Fig. 8). |
| 10 | Save | The current measurement is saved. |

Immediate visual supervision is simplified by partially colored presentation of the results, both within the Measurement window (hardness result and history) and in the Statistics window for display of individual results (refer to chapter 5.5.2). The color coding is as follows:

*Table 8: Color Coding of Measuring Results*

| *Color* | *Meaning* |
|---|---|
| **Dark Gray** | **Result with no specified limits** |
| **Green** | **Result within tolerance** |
| **Red** | **The tolerance range has been exceeded** |
| Light Gray | Result has been deleted |

The operation is supported by several keys provided in the Measurement window, as detailed below:

**-key:**

The so-called TOGGLE key allows navigation within the Measurement window, to jump from one range or input field to another. First press to activate the Toggle mode. Afterwards, it is possible to change between Upper Limit, Lower Limit, Impact direction, Settings and Save button. The currently activated item is always marked, so that adjustments or other functions can be carried out.

Note that in Toggle mode SCALE, MAT, DEL and STAT keys are disabled.

During the recording of a series (refer to chapter 5.7) only the impact direction can be toggled and changed.

**SCALE-key:**

This function is used to change the hardness scale. It is possible to decide within the systems settings whether a change is intended to take place either by automatic selection of the following valid scale, or via dialog window (refer to chapter 6.3). If possible, all results recorded up to that moment are automatically converted into the new scale, including statistics (refer to Appendix 1: Conversion ranges).

Hardness values that cannot be converted to the new hardness scale are displayed as 0.

**MAT-key:**

This function is used to change the material. It is possible to decide within the systems settings whether a change takes place by automatic selection of the following material or via dialog window (refer to chapter 6.3). If the currently selected hardness scale is not defined for the material chosen, the hardness scale automatically returns to HL.

> *i* When changing the material, results recorded up to that moment are automatically deleted, a possibly loaded measurement parameter set is reset.

**DEL-key:**

The last measuring result is erased. It appears in the results history all the same, but appears grayed out. Pressing the DEL key again deletes the second last result etc.

> *i* If six or more results have already been deleted, this function is also applied to results no more present in the results history.

**STAT-key:**

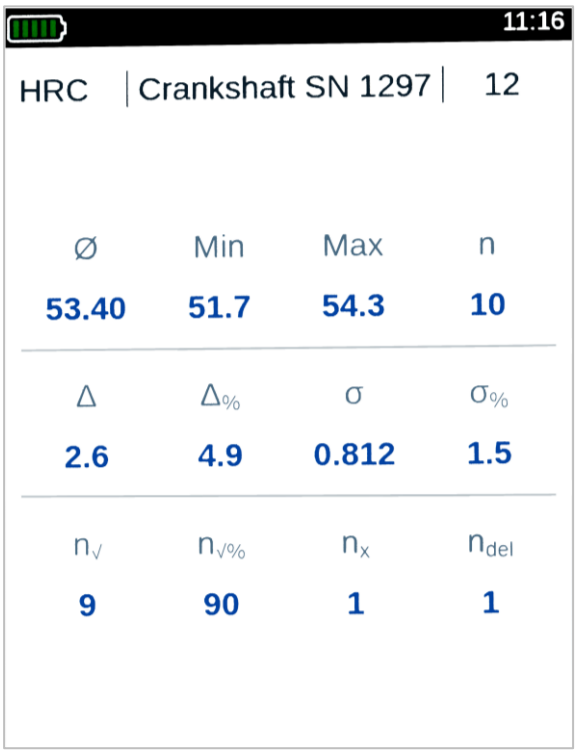
This key opens the Statistics window respectively toggles between Statistics window and display of individual results (refer to chapter 5.5.2).

### 5.5.2 Statistics Window

The statistic window is called up when:

- The number (n) of measurements specified in the measurement parameters has been reached,
- the STAT-key is pressed,
- a series of a serial series is complete,
- or a series is opened from the menu **Data management / Display series**.

Fig. 10 shows an example:




| | |
|---|---|
| **Header** | Hardness scale \| Name of series/serial series \| No. of series within serial series |
| **Ø** | Average |
| Min | Minimum |
| Max | Maximum |
| n | Number of measurements (deleted elements are not counted) |
| Δ | Absolute span between minimum and maximum |
| $\Delta_{\%}$ | Relative span referring to average |
| σ | Absolute standard deviation |
| $\sigma_{\%}$ | Relative standard deviation |
| $n_{\checkmark}$ | Quantity of measurements within tolerance |
| $n_{\checkmark\%}$ | Percentage of measurements within tolerance |
| $n_{\times}$ | Percentage of measurements outside tolerance |
| $n_{del}$: | Quantity of deleted measurements |

*Fig. 10: Statistics window*

Pressing the STAT-key from Statistic windows changes over to the display of individual results. All results of the series are listed and numbered, color coded as described in Table 8. Fig. 11 shows the display of individual results matching Fig. 10.

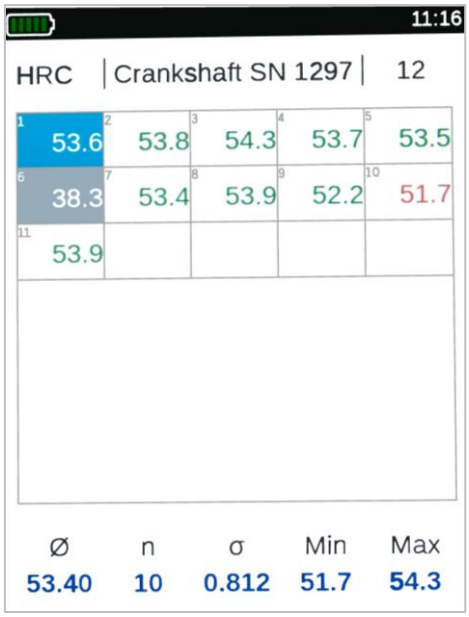



*Fig. 11: Display of individual results*

The currently selected result is marked. Use the arrow keys to change between the items, and the DEL – key to erase the currently selected element. In the latter case, the statistics are updated at once. If results have been deleted, a dialog appears during closure of the Statistics window, to decide whether modifications are intended to be accepted or discarded.

> *i* Activated instant printout blocks the DEL function. Subsequent deleting is also not possible, if a series has been called up via menu point **Data management / Display series**.

The Statistic windows is closed by ESC. If the preset number of measurements has not yet been reached (because the statistics by STAT key are activated earlier, or a result has been deleted during editing), the measurement continues.

In the configuration - refer to chapter 6.3 -, it is possible to decide, whether the Save dialog is not only intended to appear when closing the Measurement window, but also when leaving the Statistics window (provided that the specified number of measurements has been reached). In this case, the current results are stored as series and the preset number for statistics is reset, so that the series afterwards may be resumed.

## 5.6 Management of Measurement Parameter Sets

Generally, the measurement parameters specified under chapter 5.4, are provided. The system enables combinations of these parameters to be implemented and stored with a user defined name, so the desired parameter set may quickly be retrieved. However, this function requires that an impact device that corresponds to the type defined in this parameter set has been connected beforehand.

Storing a parameter set includes:

- A user defined name
- Impact device type (of the impact device connected during storing process)
- Material
- Hardness scale
- Tolerance limits
- Instant printout (ON/OFF)
- Number for statistics

Currently selected measurement parameters can be edited under menu point **Measurement Parameters / Edit**. If this procedure is intended for a parameter set stored earlier, first load it.

In order to store the currently selected measurement parameters, use menu point **Measurement Parameters / Save**, which opens a dialog box to enter a new name for this set.

Parameter sets stored beforehand can be retrieved by **Measurement Parameters / Load**. When calling up the Measurement window for the next time, the designation of the loaded set is shown, and the parameters are automatically applied.

To erase a stored parameter set, use menu point **Measurement Parameters / Delete**.

## 5.7 Management of Series and Serial Series

Up to 1.000.000 results may be stored within the internal memory of the dynaROCK III, all of them organized in series of measurements. A measurement series is defined as a set of results, recorded in form of single series or serial series. A serial series consists of several single series with identical measurement parameters.

The Measurement window furthermore offers the possibility to capture measurements without establishing a series or serial series beforehand. When storing these elements by Save button, a selectable name may be assigned by text input. After completion of text entry, the measurements are saved as a single series under this chosen designation (refer to following section).

> *i* In series or serial series SCALE and MAT keys are disabled. Only the impact direction can be changed.

### 5.7.1 Series

Already before starting the measurement, a series may be agreed under menu point **Data management / Start new series**, meanwhile specifying a name for subsequent identification. After completion of entry, the Measurement window opens automatically.

> *i* Note that always the currently valid measurement parameters are used for a series. This means that the desired parameter set must be loaded beforehand, since a change of parameters is no more possible while the series is recorded.

When leaving the Measurement window, a dialog is opened to ask whether the series is intended to be stored. If this is confirmed, the measurements are saved under the previously defined name.

To resume a previously stored series, use **Data management / Continue series**. Results registered in the following, are appended to the already existing elements.

The content of a series may be viewed together with statistical information (refer to chapter 5.5.2). For this purpose, the menu point **Data management / Display series** is provided.

It is advisable to sometimes remove series no more required (by menu point **Data management / Delete series**). This may be of interest to prevent confusion.

### 5.7.2 Serial Series

A serial series measurement is composed of single series, all of them with identical measurement parameters and the same quantity of measurements. Within the serial series, the series are numbered consecutively, all of them with the same designation. A serial series therefore represents a comfortable tool to summarize series with identical parameters, e.g. for quality control of a large batch of equal objects.

In order to establish a serial series, use menu point **Data management / Start new serial series**, meanwhile specifying a new name and then the number of measurements to be performed per series. As soon as the entry is complete, the Measurement window automatically opens, and the first series may be launched. When the specified number of measurements is reached, the Statistics window automatically opens. After closure of this window, the system is ready for the next series. The number of series to be contained in a serial series is not limited. Name of serial series, number of the current series and quantity of measurements in this series are continuously displayed in the Measurement window.

Complete series of a serial series are stored automatically. If the Measurement window is left before the end of a series, a prompt appears to decide whether incomplete series are intended to be saved as well.

> *i* Note that always the currently valid measurement parameters are used for a serial series. This means that the desired parameter set must be loaded beforehand, since a change of parameters is no more possible with a serial series running.

To resume a previously stored serial series, select it and use menu point **Data management / Continue serial series**. Results recorded in the following, are appended to the loaded serial series, together with time and date. Measurement parameters are automatically reset to the settings valid for the selected serial series. If the last subordinary series is not yet complete, it is continued, otherwise the next subordinate series is launched.

The content of a series measurement may be viewed together with statistical information (refer to chapter 5.5.2). For this purpose, the menu point **Data management / Display series** is provided. For series in a serial series, subsequent deleting of individual results is no more possible.

A serial series no more required can be removed by menu point **Data management / Delete series**. Note that particular series of a serial series cannot be discarded individually. Always the serial series as a whole disappears.

## 5.8 Description of the Test Procedure

In order to perform a test by means of the dynaROCK III, an impact device must be connected and the Measurement window opened. Before initiating actual measurements, perform a functional control acc. to chapter 4.3.3.

> *i* If the results should considerably deviate from the average of the test block or prove to be excessively scattering, return the equipment to BAQ.

Fig. 12 illustrates the components of impact device type D, comprised in the standard delivery.


1 – Release button
2 – Tensioning sleeve
3 – Guide tube
4 – Coil part
5 – Support ring
6 – Impact body
7 – Connecting cable

*Fig. 12: Components of impact device type D*

After completion of functional control, set up or load the desired measuring parameters. Then the measurement itself can be started, strictly following the procedure described below.

Tensioning

Tensioning of the impact device is only admissible in absence of contact to the sample. For stretching, hold it with one hand by the case, while shifting the sleeve slowly and uniformly towards the case (with the other hand), up to the stop. Afterwards, the sleeve can be shifted back slowly to its initial position.

Positioning of the Impact Device

Position the impact device together with the support ring on the desired test point, so that the ring is in firm and even contact with the surface. With one hand, hold the impact device in place at the case.

> *i* The impact direction must correspond to the previously specified direction.

Measurement Start

Use the release button at the upper end of the impact device to initiate the measurement. It is essential that sample and impact device remain stably fixed in position the course of the test. After completion, the detected hardness value is immediately displayed on the dynaROCK III, accompanied by an acoustic signal.

*Fig. 13: Test with impact device type D*

It is recommended to carry out several measurements (≥ 3) for each test point and to use the average. For this reason, repeat the described procedure. Minimum distances to the border and between two indentations must be respected, as listed in Table 4.

> ! Never attempt to tension the device when it is already in position. This does not only affect the material of the intended test point, but may also damage the gripping mechanism.

Operators should familiarize themselves with the equipment by means of the test block included in the delivery. This way, detected results can be checked directly on the basis of the set value. After some training, they will be able to obtain reliable and repeatable results without any problem.

## 5.9 Result Logs and Data Transfer

### 5.9.1 Copy of the Series to USB Stick

Use menu point **Data management / Copy to USB flash drive** to transfer series from the internal memory to USB stick. A USB stick together with manuals is included in the delivery, to be connected via adapter (USB A ↔ USB C), part of the delivery as well, to the dynaROCK III. Generally, the USB stick in use has to be formatted as FAT32 with MBR.

Files are stored on the stick in .csv format (character code UTF8), and can be opened for further analysis by all usual word processing or spreadsheet programs (e.g. Microsoft Excel). During import of a .csv file into a spreadsheet program, select character set Unicode UTF8, otherwise special characters cannot be correctly displayed. For separation, make exclusively use of semicolon. If analysis is expected to take place as a routine, prepare a template for the spreadsheet program, so that evaluation incl. diagrams, runs automatically during input of the .csv file.

During transfer of a serial series, several files are stored. On the one hand, a large file is created, summarizing all subordinate series, furthermore a subdirectory with the name of the serial series, in which all of the subordinated series are stored one by one (same format as single series).

> *i* The supplied USB stick contains a template for Excel that allows the exported measurement series to be easily imported and analyzed.

### 5.9.2 Format of .csv files

**Single series and series of serial series**

Version; <(1, 0, 0)>

Impact device;<Probetype>

Name;<file name>

Lower tolerance limit;<e.g. 0>

Upper tolerance limit;<e.g. 0>

Material name;<e.g. Steel and cast steel>

Hardness scale;<e.g. HLD>

Number of readings;<e.g. 5>

Mean value;<e.g. 774.2>

Minimum;<e.g. 769>

Maximum;<e.g. 780>

Standard deviation;<e.g. 3.7>

rel. Standard deviation %;<e.g. 0.48>

Value /<Hardness scale>;Impact direction*;Year;Month;Day;Hour;Minute;Deleted

776;0;2024;9;23;10;51; <reading 1>

…. <more readings>

774;0;2024;9;23;10;51; <reading5>

**Summary serial series**

Version; <(1, 0, 0)>

Impact device;<Probetype>

Name;<file name>

Lower tolerance limit;<e.g. 0>

Upper tolerance limit;<e.g. 0>

Material name;<e.g. Steel and cast steel>

Hardness scale;<e.g. HLD>

Number of series;<e.g. 25>

Number of readings per series;<e.g. 5>

Series name;<name of subordinate single series: 1>

Number of readings;<e.g. 5>

Mean value;<e.g. 321.6>

Minimum;<e.g. 312>

Maximum;<e.g. 334>

Standard deviation;<e.g. 10.1>

rel. Standard deviation;<e.g. 3.15>

Value /<Hardness scale>;Impact direction*;Year;Month;Day;Hour;Minute;Deleted

312;0;2024;9;24;11;50; <reading 1>

…… <more readings>

330;0;2024;9;24;11;50; <reading 5>

Series name;<name of subordinate single series: 2>

Number of readings;<e.g. 5>

Mean value;<e.g. 322.4>

Minimum;<e.g. 316>

Maximum;<e.g. 329>

Standard deviation;<e.g. 4.3>

rel. Standard deviation;<e.g. 1.34>

Value /<Hardness scale>;Impact direction*;Year;Month;Day;Hour;Minute;Deleted

320;0;2024;9;24;11;52; <reading 1>

…… <more readings>

329;0;2024;9;24;11;52; <reading 5>

…….. <more subordinate single series>

Series name;<name of subordinate single series: 25>

Number of readings;<e.g. 5>

Mean value;<e.g. 320.8>

Minimum;<e.g. 315>

Maximum;<e.g. 328>

Standard deviation;<e.g. 4.5>

rel. Standard deviation;<e.g. 1.41>

Value /<Hardness scale>;Impact direction*;Year;Month;Day;Hour;Minute;Deleted

315;0;2024;9;24;12;18; <reading 1>

…… <more readings>

322;0;2024;9;24;12;18; <reading 5>

* The numbers for the impact direction stand for:

0 

45 

90 

135 

180 

*i* Incomplete series of a serial series are not transferred.

# 6 System Settings

The following sections describe possibilities for changing the default system settings.

## 6.1 Language

Specify the desired language in the selection dialog under **System / Language**, confirm it by OK and press ENTER key.

## 6.2 Time and Date

Time and date can be manually altered under menu point **System / Set Date and Time**, whereas the date format is chosen under Configuration (refer to chapter 6.3).

> *i* It can sometimes take 1 or 2 minutes for the changed time to be adopted.

## 6.3 Configuration

Configuration possibilities are subdivided into user and instrument configuration, both of them available under menu point **System**.

**User Configuration**

These settings relate to the operation and procedures when performing tests, as follows:

SCALE-key:

Define the reaction of the SCALE key in the Measurement window. It is possible to decide whether a change of scale is intended to take place either by automatic selection of the following valid scale (**Next Scale**) or via dialog window (**Open Dialog**).

MAT-key:

Reaction of the MAT key in the Measurement window. Choose between **Next Material** (automatic selection of the following valid material) and **Open Dialog**.

Tensile Strength unit

Choose between MPa and N/mm².

Query: save series on close

Select whether during closure of the Measurement window an inquiry is intended to appear, which asks if results are to be stored as series. The inquiry can be activated or disabled by ENTER as well as by arrow keys ◄ and ►.

Query: save series if n is defined

For measurements with a defined number for statistics (n), it can be set whether an inquiry appears when leaving the statistics window (when n is reached) as to whether the measured results should be saved as a series. The inquiry can be activated or disabled by ENTER as well as by arrow keys ◄ and ►.

Query: print series on close

Select whether during closure of the Statistics window (if number for statistics is activated), an inquiry is intended to appear, if log printout is desired.

**Device Configuration**

Settings to be specified in this section mainly concern the display:

Date Format

| | | | | | |
|---|---|---|---|---|---|
| Select | **DD.MM.YYYY** | with | DD: Day | MM: Month | YYYY: Year |
| or | **MM/DD/YYYY** | with | MM: Month | DD: Day | YYYY: Year |
| or | **YYYY-MM-DD** | with | YYYY: Year | MM: Month | DD: Day |

## 6.4 Factory Settings

The dynaROCK III can be set back to default settings by **System / Factory Settings**.

> ! Note that this step is irreversible, so data deleted are irrevocably lost.

## 6.5 System Information

The system information is displayed under the menu item **System / About**. This includes the version numbers of the software and the circuit board and, if an impact device is connected, its type and the number of measurements.

## 6.6 Calibration of Impact Device

To each impact device, an individual calibration value is assigned which must be stored within the dynaROCK III. For every device type, an own value can be implemented. Values of devices already included in the delivery have been stored by the manufacturer.

Whenever connecting a new impact device, or a device beforehand returned for calibration to factory service without the corresponding dynaROCK III, the client himself is responsible for charging the calibration value. This value can be found on the USB stick included in the delivery. Connect the USB stick to the dynaROCK III, and implement the calibration by menu point **System / Impact device calibration**.

# 7 Troubleshooting

Even though the dynaROCK III together with impact devices represents a very rugged measuring system, errors can never completely be excluded. Action to be carried out in case of need is described in the following.

**Incorrect Results**

Faulty results occurring in spite of a correct measuring procedure (refer to chapter 5.8) require functional control acc. to instructions of chapter 4.3.3. This means that the impact body must be verified, and measurements on appropriate Leeb test blocks may be necessary, strictly in conformity with this user manual. Always check whether the sample is convenient for hardness measurements by the Leeb method (refer to chapter 4.3.2).

> *i* If the problem persists, return the unit to BAQ or consult an authorized service partner.

**Absent Connection between dynaROCK III and Impact device**

Error message „2-24 No impact device connected“ originates from a perturbed connection, which may be due to the dynaROCK III itself, the connecting cable or the impact device. Inspect the cable and all connectors including the pins inside the sockets respectively plugs.

**No Reaction of the dynaROCK III**

The absence of any reaction is very unlikely. In this case, perform a reboot by keeping pressed the POWER button for about 8 seconds. The system shuts down automatically and restarts afterwards.

**Error Messages**

To each error message, a number and a text is assigned. Follow the instructions appearing on the screen. Some of the problems however cannot be corrected by the client himself. In this case contact service@baq.de or return the equipment incl. accessories to BAQ or authorized service partner.

**Error-Log**

The dynaROCK III automatically detects critical system errors and stores them in an error log file. Such errors can also occur internally within the device, so they may not be shown on the display. The error

log file is solely for troubleshooting by BAQ. To send the file to BAQ, it can be transferred to a USB stick via the menu point **System / Copy error log to USB** and then sent by email to service@baq.de.

# 8 Maintenance and Support

Regular cleaning and preventive maintenance of both dynaROCK III and impact devices contribute to trouble-free operation and extend the lifetime of the equipment. In order to constantly ensure reliable and repeatable measurements over the entire hardness range, yearly calibration by BAQ or an authorized service partner is advisable. Detailed information about recommended intervals is specified in the standards.

**Cleaning**

From time to time, clean the instrument itself, as well as the impact devices, accessories and connection cables. A cloth soaked with isopropyl alcohol may be used for this purpose. Plugs and sockets may be cleaned by a clean and dry brush.

Cleaning of impact devices is imperative at the latest after 1000 measurements. For that purpose, unscrew the support ring, remove the impact body and insert the brush included in the delivery several times up to the end of the guide tube, meanwhile rotating counterclockwise, then pull it out. For the impact body, use a cloth soaked with isopropyl alcohol. After completion, reassemble the impact device.

> ! Do not use sharp objects, aggressive substances or scouring agents.

**Storage and Transport**

The dynaROCK III as well as accessories have to be stored in the case provided, in a dry, clean and dust-free environment. The cutouts within the case inlay reliably protect the content, so always make use of that case whenever transporting or shipping the instrument.

**Updates**

Software updates for the dynaROCK III will be released throughout the product life cycle. To install a software update, a USB stick with the new software version must be inserted into the USB socket of the dynaROCK III (if necessary, using the USB A ↔ USB C adapter included in the scope of delivery). The software update can then be started under the menu point **System / Software update**. Follow any further instructions on the display.

**Disposal**

The dynaROCK III is not admitted for removal by conventional domestic, industrial or commercial waste. In case of need, consult us for information about correct removal of electronic equipment.

# 9 Appendix 1: Conversion ranges

*Table 9: Conversion areas*

| *Material* | *Hardness scale* | *Impact device type* | | | | |
|---|---|---|---|---|---|---|
| | | *D / DC* | *D+15* | *C* | *G* | *DL* |
| ***Steel and cast steel*** | HRC | 20.0 – 68.4 | 19.7 – 67.7 | 20.1 – 63.2 | - | 20.7 – 67.8 |
| | HRB | 38.4 – 99.5 | - | - | 47.7 – 99.9 | 38.4 – 99.5 |
| | HB | 81 – 654 | 82 – 637 | 80 – 683 | 90 – 646 | 82 – 644 |
| | HV | 81 – 955 | 81 – 928 | 80 – 789 | - | 81 – 939 |
| | HS | 29.7 – 99.5 | 33.6 – 98.9 | 31.8 – 87.2 | - | 30.9 – 96.2 |
| | MPa / N/mm² | 258 – 2180 | - | - | 304.1 – 2173 | 258 – 2159 |
| ***Tempering steel, heat treated*** | HRC | 20.0 – 68.4 | - | - | - | 20.7 – 67.8 |
| | HRB | 38.4 – 99.5 | - | - | 38.4 – 99.5 | 38.4 – 99.5 |
| | HB | 81 – 654 | - | - | 81 – 654 | 82 – 644 |
| | HV | 81 – 955 | - | - | - | 81 – 939 |
| | HS | 29.7 – 99.5 | - | - | - | 30.9 – 96.2 |
| | MPa / N/mm² | 654.2 – 1454 | - | - | 654.2 – 1460 | 651 – 1451 |
| ***Tempering steel, annealed*** | HRC | 20.0 – 68.4 | - | - | - | 20.7 – 67.8 |
| | HRB | 38.4 – 99.5 | - | - | 38.4 – 99.5 | 38.4 – 99.5 |
| | HB | 81 – 654 | - | - | 81 – 654 | 82 – 644 |
| | HV | 81 – 955 | - | - | - | 81 – 939 |
| | HS | 29.7 – 99.5 | - | - | - | 30.9 – 96.2 |
| | MPa / N/mm² | 460 – 826 | - | - | 503 – 823 | 460 – 826 |
| ***Tempering steel, hardened*** | HRC | 20.0 – 68.4 | - | - | - | - |
| | HRB | 38.4 – 99.5 | - | - | 38.4 – 99.5 | - |
| | HB | 81 – 654 | - | - | 81 – 654 | - |
| | HV | 81 – 955 | - | - | - | - |
| | HS | 29.7 – 99.5 | - | - | - | - |

| *Material* | *Hardness scale* | *Impact device type* | | | | |
|---|---|---|---|---|---|---|
| | | *D / DC* | *D+15* | *C* | *G* | *DL* |
| ***Cold work tool steel*** | HRC | 20.4 – 67.1 | 19.8 – 68.1 | 20.7 – 67.9 | - | - |
| | HV | 80 – 898 | 81 – 933 | 100 – 932 | - | - |
| ***Stainless steel*** | HRC | 19.6 – 62.4 | - | - | - | - |
| | 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 – 84.9 | 23.8 – 85.5 | - |
| ***Brass (copper-zinc alloys)*** | HB | 40 – 173 | - | - | - | - |
| | HRB | 13.5 – 95.3 | - | - | - | - |
| ***Bronze (copper-aluminium /copper-tin alloys)*** | HB | 60 – 290 | - | - | - | - |
| ***Wrought copper alloys*** | HB | 45 – 315 | - | - | - | - |

# 10 Appendix 2: Order information

**Instrument and instrument accessories**

| *Item-No.* | *Description* |
|---|---|
| 22-100 | Rebound hardness tester dynaROCK III with impact device D, HLD test block, USB charger, robust aluminum housing and BAQ factory certificate. |
| 22-100exD1 | Rebound hardness tester dynaROCK III As item 22-100, but without impact device |
| 22-100exD2 | Rebound hardness tester dynaROCK III as item 22-100, but without impact device and without test block |
| 22-112 | Mobile printer for dynaROCK |
| 22-113 | Carrying bag with shoulder strap for dynaROCK III |
| R-RP-KABEL-V2 | Connection cable hardness tester – impact device Lemo push-pull connector and Binder screw lock |
| 22-130 | USB-Charger for hardness tester dynaROCK III including cable |
| 22-130-UK | Adapter for charger (UK) – Connector type G |
| 22-130-US | Adapter for charger (US/CA) – Connector type A |

**Impact devices and impact device accessories**

| *Item-No.* | *Description* |
|---|---|
| 22-120 | Impact device D for hardness tester dynaROCK<br>Standard impact device for most hardness testing tasks |
| 22-121 | Impact device DL for hardness tester dynaROCK<br>Impact device with thin extension (Ø4.2 mm), e.g. for measurements in drill holes |
| 22-122 | Impact device DC for hardness tester dynaROCK<br>Extremely short impact device for measurements at inaccessible locations |
| 22-123 | Impact device D+15 for hardness tester dynaROCK<br>The impact device has a recessed reactance coil and a smaller placement surface (11 mm x 14 mm instead of Ø 20 mm) for hardness measuring in slots and deepened areas. |
| 22-124 | Impact device C for hardness tester dynaROCK<br>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. |
| 22-125 | Impact device G for hardness tester dynaROCK<br>Impact device with increased impact energy e.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. |
| R-RP-SK-D | Impact body type D |
| R-RP-SK-DL | Impact body type DL |
| R-RP-SK-C | Impact body type C |
| R-RP-SK-G | Impact body type G |
| R-RP-AL-01 | Support ring for Impact device, Ø14 mm |
| R-RP-AL-02 | Support ring for Impact device, Ø20 mm |
| 21-110 | Set of support rings for convex and concave surfaces, 12 pieces |

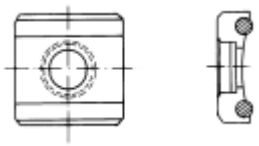
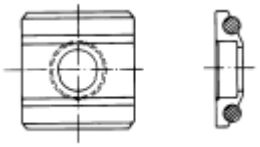
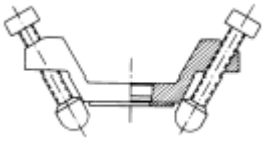
**Leeb hardness test blocks**

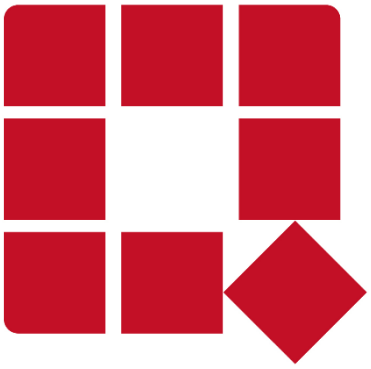
| *Item-No.* | *Description* |
|---|---|
| HVP-HLD | Test block for Leeb hardness tester<br>Ø90 x 55 mm, 2.73 kg<br>Engraved hardness scales: HLD, HLDL, HLD+15, HLC<br>Possible hardness values: 530±40 HLD, 630±40 HLD, 790±40 HLD |
| HVP-HLD-Z | Test block for Leeb hardness tester type HLD with DAkkS certificate conform to DIN EN ISO 16859 or ASTM A 956<br>Ø90 x 55 mm, 2.73 kg<br>Possible hardness values: 530±40 HLD, 630±40 HLD, 790±40 HLD |
| HVP-HLG | Test block for Leeb hardness tester type HLG<br>Ø120 x 70 mm, 6.17 kg<br>Possible hardness values: 500±40 HLG, 590±40 HLG |
| HVP-HLG-Z | Test block for Leeb hardness tester type HLG with DAkkS certificate conform to DIN EN ISO 16859 or ASTM A 956<br>Ø120 x 70 mm, 6.17 kg<br>Possible hardness values: 500±40 HLG, 590±40 HLG |

**Repair and calibration**

| *Item-No.* | *Description* |
|---|---|
| R-RP-KAL-01 | Calibration of Leeb hardness tester including BAQ quality certificate. Test measurements on certified test blocks. |
| R-RP-KAL-02 | DAkkS calibration for Leeb hardness tester with impact device D according to DIN EN ISO 16859-2 made by an official DKD accredited laboratory. |
| R-RP-KAL-03 | DAkkS calibration for Leeb hardness tester with impact device D according to ASTM A 956 made by an official DKD accredited laboratory. |

*Table 10: Complete set of support rings (available as an option)*

| No. | Type | Drawing of the mounting ring | Notes |
|---|---|---|---|
| 1 | Z10-15 |  | For convex surfaces<br>R10 - R15 |
| 2 | Z14.5-30 | | For convex surfaces<br>R14.5 - R30 |
| 3 | Z25-50 | | For convex surfaces<br>R25 - R50 |
| 4 | HZ11-13 |  | For concave surfaces<br>R11 - R13 |
| 5 | HZ12.5-17 | | For concave surfaces<br>R12.5 - R17 |
| 6 | HZ16.5-30 | | For concave surfaces<br>R16.5 - R30 |
| 7 | K10-15 |  | For balls<br>SR10 - SR 15 |
| 8 | K14.5-30 | | For balls<br>SR14.5 - SR 30 |
| 9 | HK11-13 |  | For hollow bodies<br>SR11 bis SR13 |
| 10 | HK12.5-17 | | For hollow bodies<br>SR12.5 bis SR17 |
| 11 | HK16.5-30 | | For hollow bodies<br>SR16.5 bis SR30 |
| 12 | UN |  | For convex surfaces,<br>Radius adjustable R10 bis ∞ |



**BAQ GmbH**

Hermann-Schlichting-Str. 14
38110 Braunschweig
Deutschland

Tel: +49 5307 / 95102 - 0
Fax: +49 5307 / 95102 - 20
Mail: info@baq.de / service@baq.de
Web: www.baq.de