dynaROCK
Leeb Hardness Tester

Manual

BAQ

Contents

1 Overview

1.1 dynaROCK Advantages

- Wide measuring range. Based on the principle of Leeb hardness testing theory. It can measure the Leeb hardness of most metallic materials.
- Large screen(128×64 dot matrix LCD), showing all functions and parameters.
- Test at any angle, even upside down.
- With EL background light.
- Direct display of HRB, HRC, HV, HB, HS, HL hardness scales
- Seven impact devices are available for special application. Automatic identification of the type of impact devices.
- Large capacity memory can store 500 groups (relative to average times 32 to 1) information including single measured value, mean value, testing date, impact direction, impact times, material and hardness scale etc.
- Upper and lower limit can be preset. It will alarm automatically when the result value exceeding the limit.
- Battery information indicates the rest capacity of the battery.
- Software calibration function.
- Software to connect with PC via RS232 port. Micro printer support.
- Compact metal case; suitable for use under poor working conditions
- Continuous working period of no less than 50 hours with two alkaline batteries(AA size). Auto power-off to save energy.
- Outline dimensions: 132 X 76.2 mm
- Weight: 345g

1.2 Main Application &Testing Range

1.2.1 Main Application

- Die cavity of molds
- Bearings and other parts
- Failure analysis of pressure vessel, steam generator and other equipment
- Heavy work piece
- The installed machinery and permanently assembled parts.
- Testing surface of a small hollow space
- Material identification in the warehouse of metallic materials
- Rapid testing in large range and multi-measuring areas for large-scale work piece

1.2.2 Testing Range

Refer to Table 3 and Table 4 in the Appendix.

1.3 Configuration

	No.	Item	Quantity	Remarks
Standard Configuration	1	Main unit	1	
	2	D type impact device	1	With cable
	3	Standard test block	1	
	4	Cleaning brush	1	
	5	Small support ring	1	
	6	Alkaline battery	2	AA size
	7	Manual	1	
	8	Instrument case	1	
	9	Connection cable	1	
	10	Belt	1	
Optional Configuration	11	Other type of impact devices and support rings		Refer to Table 5 and Table 6 in the appendix.
	12	Micro Printer	1	

1.4 Working Conditions

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

The surrounding environment should be devoid of vibration, strong magnetic field, corrosive medium and heavy dust.

2 Structure Feature & Testing Principle

2.1 Structure Feature

2.1.1 The Hardness Tester Appearance

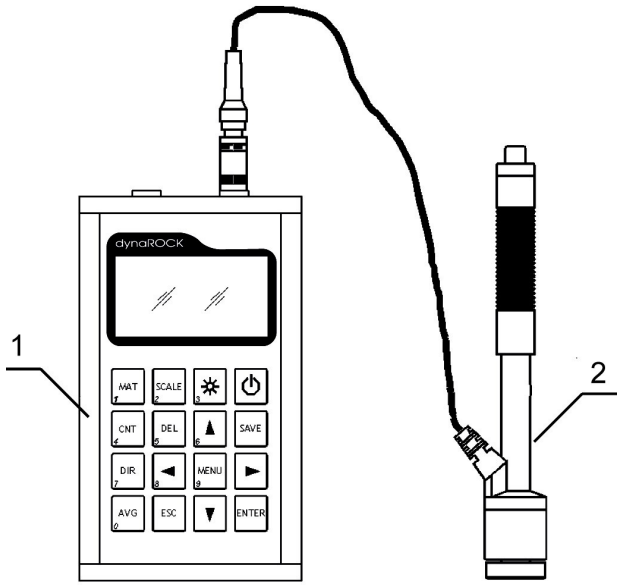


Figure 1:

1 - Main unit
2 - Impact device

2.1.2 Parts of the main unit

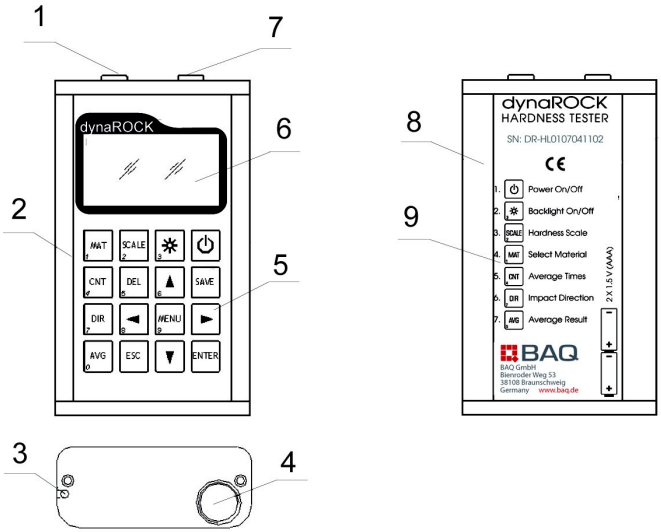
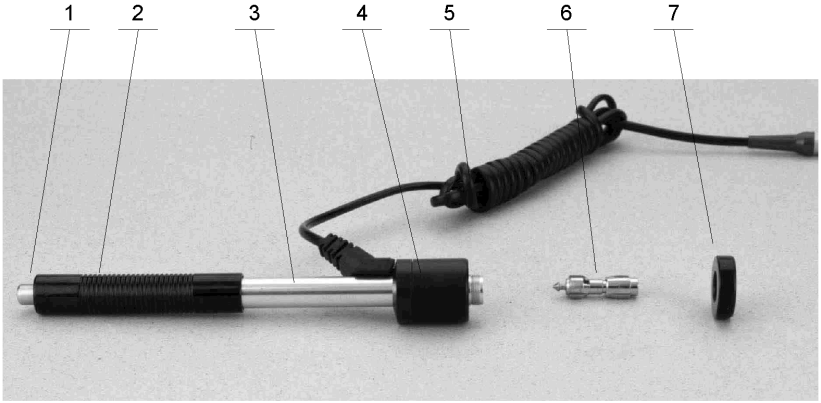


Figure 2:

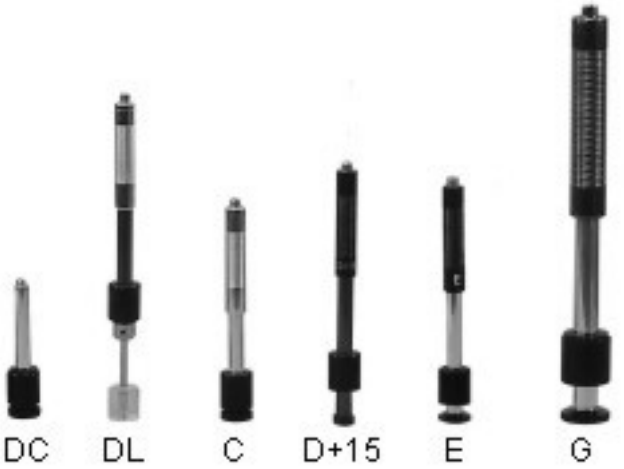
1 - Socket of RS232
2 – Aluminium case
3 – Belt hole
4 – Battery cover
5 - Keypad
6 – LCD Display
7 – Impact device socket
8 – Aluminium case
9 – Label

2.1.3 D Type Impact Device



1 – Release button
2 – Loading tube
3 – Guide tube
4 – Coil unit
5 – Connection cable
6 – Impact body
7 – Support ring

2.1.4 Different Types of Impact Device



2.2 Leeb Hardness Testing Principle

The basic principle is: to use an impact body of certain weight impacting against the testing surface under certain test force and to then measure the impacting velocity and the rebounding velocity of the impact body respectively when the spherical test tip is located 1mm above the testing surface.
The calculation formula is as follows:

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

Where:

HL — Leeb hardness value
VB — Rebounding velocity of the impact body
VA — Impacting velocity of the impact body

3 Technical Specifications

See Table 1 for error and repeatability of displayed value/s.

No.	Type of impact device	Hardness value of Leeb standard hardness block	Error of displayed value	Repeat-ability
1	D	760±30HLD 530±40HLD	±6 HLD ±10 HLD	6 HLD 10 HLD
2	DC	760±30HLDC 530±40HLDC	±6 HLDC ±10 HLDC	6 HLD 10 HLD
3	DL	878±30HLDL 736±40HLDL	±12 HLDL	12 HLDL
4	D+15	766±30HLD+15 544±40HLD+15	±12 HLD+15	12 HLD+15
5	G	590±40HLG 500±40HLG	±12 HLG	12 HLG
6	E	725±30HLE 508±40HLE	±12 HLE	12 HLE
7	C	822±30HLC 590±40HLC	±12 HLC	12 HLC

Table 1:

- Measuring range 170HLD to 960HLD
- Measuring direction 360°
- Hardness scale HL, HB, HRB, HRC, HRA, HV, HS
- Display dot matrix LCD 128×64 dots
- Data memory max. 500 groups, relative to impact times 32 to 1
- Working voltage 3V, 2 AA size alkaline battery
- Continuous working period about 100 hours 8(with backlight off)
- Communication interface RS232

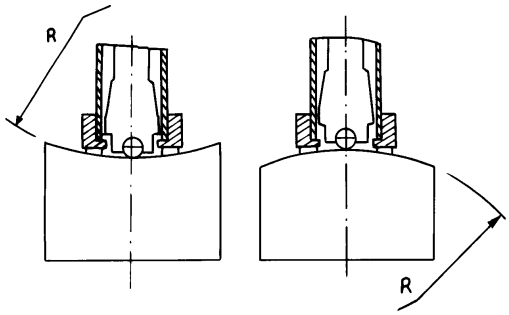
4 Preparation & Testing

4.1 Preparation & Inspection before Testing

4.1.1 Preparation of Sample Surface

Preparation for sample surface should conform to the relative requirement in the Appendix Table 5 on page 33.

- In the preparation processing for sample surface, the hardness effect of being heated or cold processing on the surface of sample should be avoided.
- Too big roughness of the being measured surface could cause measure error. So, the surface of the sample to be measured must appear metallic lustre, smoothing and polish, without oil stain.
- Support of test sample. Support is no necessary for heavy sample (see Table 5 on page 33). Medium-weight parts must be set on the smoothing and stable plane (see Table 5 on page 33). The sample must be set absolutely evenly and without any wobble .
- Curved surface: The best testing surface of sample is flat. When the curvature radius R of the surface to be tested is smaller than 30mm (D, DC, D+15,C, E and DL type of impact device) and smaller than 50mm (G type of impact device), the small support ring or the shaped support rings should be chosen.



- The sample should have enough thickness, minimum thickness of sample should conform to Table 5 on page 33.
- For the sample with hardened layer on surface, the depth of hardened layer should conform to Table 5 on page 33.
- Coupling. Light-weight sample must be firmly coupled with a heavy

base plate. Both coupled surface must be flat and smooth with no redundant coupling agent. The impact direction must be vertical to the coupled surface. When the sample is a big plate, long rod or bending piece, it can be deformed and become unstable, even though its weight and thickness is big enough (see Table 5 on page 33), and accordingly, the test value may not be accurate. The back of the sample should therefore be additionally reinforced or supported.

- Magnetism of the sample itself should be avoided.

4.1.2 System Setting

See chapter 6.9 for details.

4.1.3 Presetting Testing condition

See chapter 6.5 for details.

4.2 Testing Program

Verification of the tester is by using standard test block. The error and repeatability of displayed value should be within the regulations on Table 4 of the Appendix.

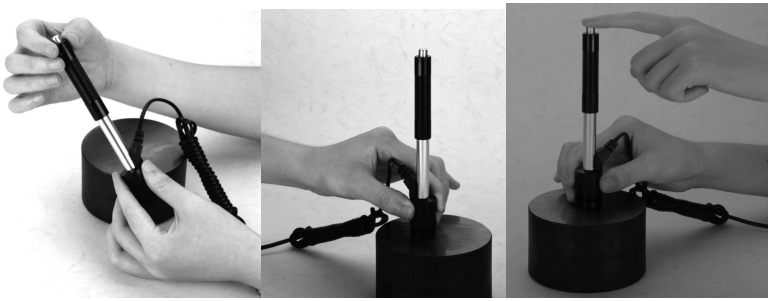
> ***Note: Use a calibrated hardness tester, test the standard test block vertically downward for five times and compare the arithmetical average value with the value of standard test block. If this value exceeds the standard value, the software calibration can be used for adjustments.***

4.2.1 Start-Up

- Insert the plug of the impact device into the socket of impact device on the tester.
- Press **[** ⏻ **]** key. Now power is connected. The instrument is in testing condition.

4.2.2 Loading

Push the loading-tube downwards until contact is felt. Then allow it to slowly return to the starting position or, using another method, lock the impact body.



4.2.3 Localization

Press the impact device supporting ring on the surface of the sample firmly, the impact direction should be vertical to the testing surface.

4.2.4 Testing

- Press the release button on the upside of the impact device to test. The sample and the impact device as well as the operator are all required to be stable now. The action direction should pass the axis of the impact device.
- Each measuring area of the sample usually needs to undergo the testing operation five times. The resulting data dispersion should not be more than the mean value ±15HL.
- The distance between any two impact points or from the center of any impact point to the edge of testing sample should conform to the regulation of Table 2.
- If accurate conversion from the Leeb hardness value to another hardness value is required, a contrastive test is needed to get conversion relations for the special material. Use an inspected, qualified Leeb hardness tester and a corresponding hardness tester to test the same sample respectively. For each hardness value, each measure homogeneously 5 points of Leeb hardness value in the surrounding of more than three indentations which need conversion hardness, using Leeb hardness arithmetic average value and corresponding hardness average value as correlative value respectively, make individual hardness contrastive curve. Contrastive curves should include at least three groups of correlative data.

Type of Impact Device	Distance of center of the two indentations	Distance of center of the indentation to sample edge
	Not less than (mm)	Not less than (mm)
D/DC	3	5
DL	3	5
D+15	3	5
G	4	8
E	3	5
C	2	4

Table 2:

4.2.5 Read measured value

4.2.6 Power Off

Press **[** ⏻ **]** key to switch off.

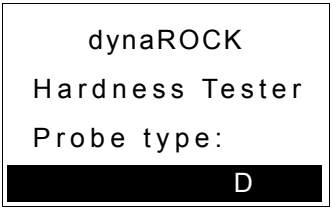
5 Advice

- Replacing the impact device must be done during Power off. Otherwise the main unit can not identify the type of the impact device, and it can damage the circuit board of the main unit.
- You could not save the current test value if the test times is less than the presetting times value. But you could press **[**AVG**]** to end the test process in advance if you want to save the values.
- When pressing **[**AVG**]** to end testing in advance, the **[**Auto save**]**, **[**Auto transfer**]** settings could not work.
- Only type D and type DC of impact device have the function of strength measure option. You can not modify the **[**Set hardness orбb**]** setting when using other types of impact device. The **[**Set hardness or σ_b**]**setting would be set to **[**Hardness**]** automatically after replacing the impact device whether the setting is **[**Hardness**]** or not before.
- Not all materials could convert to all hardness style value. The hardness style is reset to HL automatically after changing the material. So select material first before changing the hardness style.

6 Operation in Details

6.1 Power On

Press**[⏻]** to power on the system. The screen shows as below:



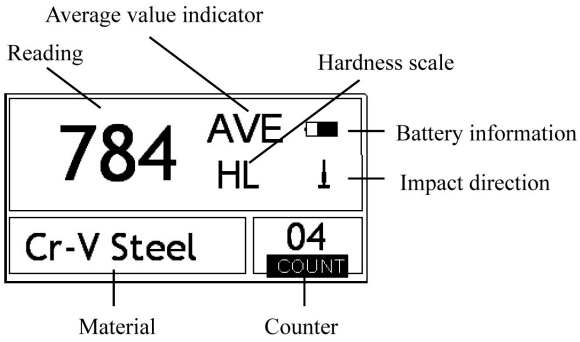
The system would automatically detect the type of the impact device during power up, and would display this information on the screen. Users should pay attention to the probe type displayed on the screen. After pausing for several second, the screen will exit and enter the main display interface.

6.2 Power Off

Press[⏻] could power off the system in any conditions.

6.3 Testing

Below is the main display interface:



6.3.1 Instruction of the Main Display Interface

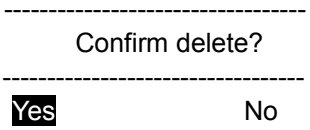
Battery information: Display the information of the rest capacity of the battery.
Impact direction: The present impact direction.
Average value indicator: It appears to show the mean value of the samples when reaching the presetting impact times.
Hardness scale: Hardness method of the present measured value.
Measured value: Display present single time measured value (without mean value indicator) or display the present mean value (with average value indicator prompting). ↑ means above conversion or measure range. ↓ means lower than conversion or measure range.
Material: The present presetting material.
Impact times count: The number of times that impacts have been carried out.

6.3.2 Testing Operation at the Main Display Interface

The testing operation can be carried out under this interface. After each impact operation, it will display the current measured value, impact times count plus one and, in addition, the buzzer will emit a long beep if the measured value is not within the tolerance limit. When reaching the presetting impact times, the buzzer will emit a long beep. After 2 seconds, the buzzer will emit a short beep, and display the mean value.

6.3.3 Key Operation at the Main Display Interface

- Press key **[**SAVE**]** to store present group of measured values into memory. This operation is only valid after the mean value has been displayed.
- Press **[**DEL**]** to delete the latest single measured value. After pressing this key, the screen will displays as below:



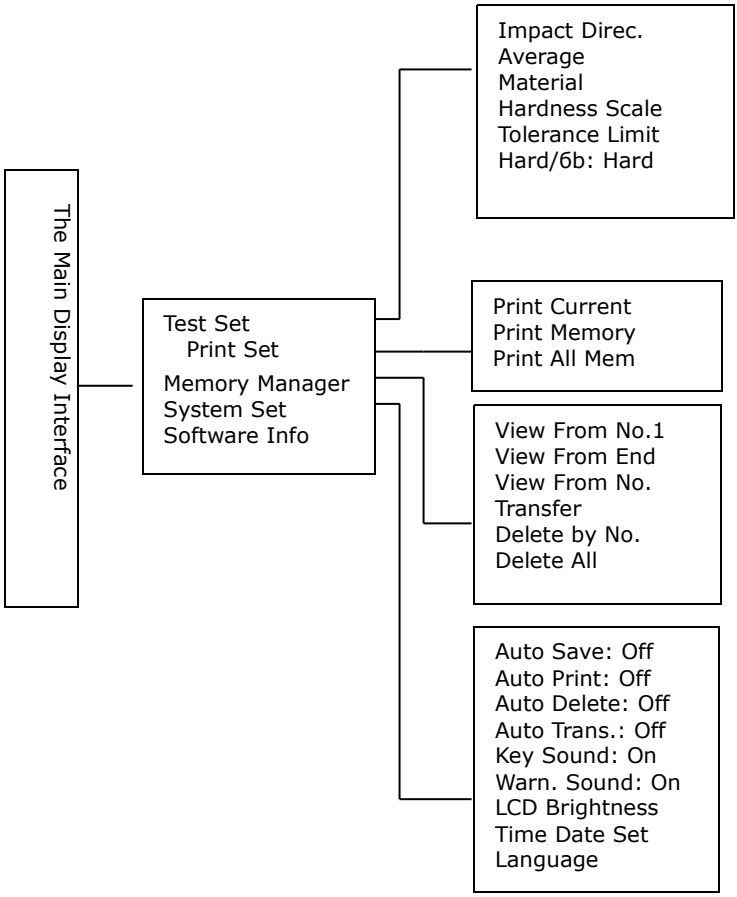
Press **[◄]** or **[►]** to move the cursor to **[**YES**]** or **[**NO**]** .
Press **[**ENTER**]** to confirm operation.
Press **[**ESC**]** to cancel delete operation.

- Pressing **[▲]** or **[▼]** will display single measured value.
- Pressing **[**AVG**]** could end off testing before reaching the presetting impact times and will display the average value.

- Pressing **[**☼**]** will switch the background light of LCD on of off.
- Pressing **[**MENU**]** will enter the system presetting menu.
- Press **[**DIR**]** to set the impact direction.
- Press **[**TIME**]** to change the impact times in one group. The impact times count item will be highlighted when first pressing the key **[**TIME**]** and the impact times count value will plus one with each pressing. The value will return to 1 when it reaches 32.
- Press **[**HD**]** to change the hardness scale.
- Press **[**MAT**]** to change the material set. Presetting hardness scale will automatically return to HL automatically after material presetting changed.

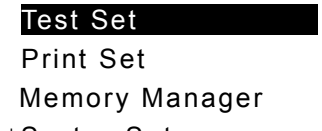
6.4 Menu Structure

Both presetting system parameters and the additional function can be realised by menu operation. At the main display interface, press **[**MENU**]** to enter the main menu.

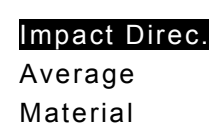


6.5 Test Set

At the main display interface, press **[**MENU**]** to enter the main menu.

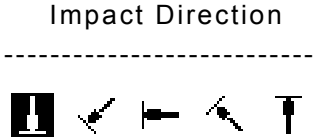


Press **[**ENTER**]** to enter Test Set Menu. The↓symbol on the left-hand side of the (underside) menu indicates that the menu has not ended. Press **[▼]** to scroll down. The ↑ symbol on the left-hand side of the (upside) menu indicates that the menu has not ended. Press **[▲]** to scroll up.



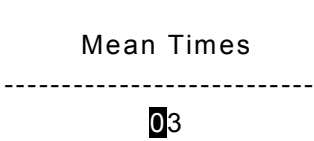
Press **[▼]** or **[▲]** to move the cursor to the line you want to set, and press **[**ENTER**]** to confirm it.
Note:1. When [Hard/6b] is switched to 6b, the hardness scale cannot be selected. The cursor will skip over [Hardness Scale] whilst in motion.
2. Only D type impact devices have the 6b measure function , therefore the cursor cannot move to [Hard/6b] when another impact device is being used.

6.5.1 Impact Direction Setting



Press **[◄]** or **[►]** to move the cursor to the impact direction that you wish to preset.
Press **[**ENTER**]** to confirm it.
Press **[**ESC**]** to cancel it.

6.5.2 Average Times Setting



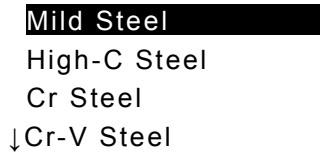
You can modify average times within the range of 1 to 32. Press the **[**0**]** to **[**9**]** keys to input the number value. The cursor will shift right around when inputting.
Press **[**ENTER**]** to confirm it.
Press **[**ESC**]** to cancel it.

6.5.3 Material Setting

When **[**Hard/σ_b**]** is preset to hardness (see chapter 6.5), it will display the following materials: Steel and Cast Steel; Cold Work Tool Steel; Stainless Steel; Gray Cast Iron; Nodular Cast Iron; Cast Aluminium Alloys; Copper-Zinc Alloys; Copper-Aluminium Alloys; Wrought Copper and Wrought Steel.

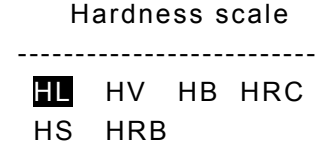
Press **[▼]** or **[▲]** to move the cursor to the material you want to preset.
Press **[**ENTER**]** to confirm it.
Press **[**ESC**]** to cancel it.
Note 1. Presetting hardness scale automatically retursn to HL after material presetting has been changed.
2. Please select material first, then select hardness scale.

When **[**Hard/ σ_b**]** is preset to 6b, it will display the following materials: Mild Steel; High-Carbon Steel; Cr Steel; Cr-V Steel; Cr-Ni Steel; Cr-Mo Steel; Cr-Ni-Mo Steel; Cr-Mn-Si Steel; Super Strength Steel and Stainless Steel.



Press **[▼]** or **[▲]** to move the cursor to the material to want to preset.
Press **[**ENTER**]** to confirm it.
Press **[**ESC**]** to cancel it.

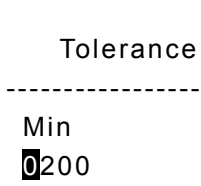
6.5.4 Hardness Scale Setting



Press **[◄]** or **[►]** to move the cursor to the hardness scale you want to preset.
Press **[**ENTER**]** to confirm setting. Press **[**ESC**]** to cancel setting.
Note: 1. Only the valid hardness scale for the present selected impact device and material is displayed here. It will not display the invalid hardness scale.
2.Please select material first, then select hardness scale.

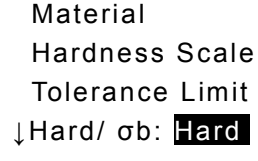
3.Presetting hardness scale automatically returns to HL after presetting material is changed.

6.5.5 Tolerance Limit Setting



Press the **[**0**]** to **[**9**]** keys to input the number value. The cursor will shift right around automatically when inputting.
Press **[**ENTER**]** to confirm setting.
Press **[**ESC**]** to cancel setting.
Note: 1. If the setting value exceeds the measure range, the instrument will remind you to reset.
2. If the bottom limit is larger than the upper limit, they will exchange automatically.

6.5.6 Hardness/6b Setting



Press **[**ENTER**]** to switch between Hard and σ_b .
Note: Only D and DC type impact devices have the σ_b measure function, hard is the only selection if the impact device is not D or DC type.

6.6 Print

At the main display interface, press **[**MENU**]** enter the main menu.

6.7 Memory Manager

Test Set
Print
Memory manager
↓System Set

At the main display interface, press **[**MENU**]** enter the main menu.

Press **[▲]** or **[▼]** to move the cursor to **[**Memory Manager**]**. Press **[**ENTER**]** into **[**Memory Manager**]** menu.
If there is no data in the memory, displays: <No Data!>. Then return.

View From No. 1
View From End
View From No.
Transfer
Delete By No.
Delete All

Press **[▲]** or **[▼]** to move the cursor to the required function , then press key **[**ENTER**]** to confirm.

6.7.1 View from No.1 Group/View from Ending Group

[View from No.1**]** Start display values in the memory from the first group.
[View from End**]** Start display values in the memory from the ending group.
See also chapter 6.8.

6.7.2 View from Selected No. Group

Select Group
From 001 to 010

001

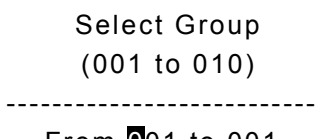
Press the digit keys to input the number.
Press **[**ENTER**]** to start displaying memory data from the selected beginning group.
Press **[**ESC**]** to cancel operation.
See also chapter 6.8.

6.7.3 Data Transfer

[Transfer**]** exports the values stored in the memory in a text format to the PC via COM port.

6.7.4 Delete by Group No.

[Delete by No.**]** displays selected range of deleting groups.

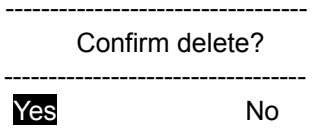


Press the digit keys to input the number.
Press **[**ENTER**]** to delete the selected groups.
Press **[**ESC**]** to cancel operation.
Note: 1. If the preset group number exceeds the actual range, it will delete the actual groups among them.
2. Do not shut down the instrument whilst deleting data as this could lead to unpredictable consequences.

6.7.5 Delete All Data

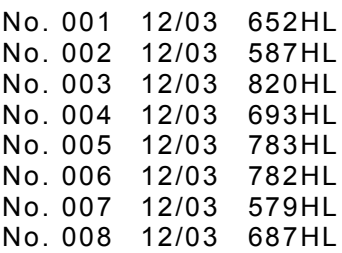
[Delete All**]** will delete all the data in the memory.

6.7.6 Deletion Confirmation

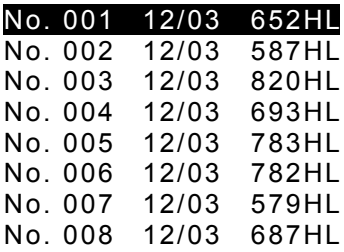


Press **[◄]** or **[►]** to move the cursor to **[**YES**]** and press **[**ENTER**]** to confirm deleting operation.
Press **[◄]** or **[►]** to move the cursor to **[**NO**]** and press **[**ENTER**]** to cancel deleting operation.
Pressing **[**ESC**]** could cancel the deleting operation, no matter where the cursor is.

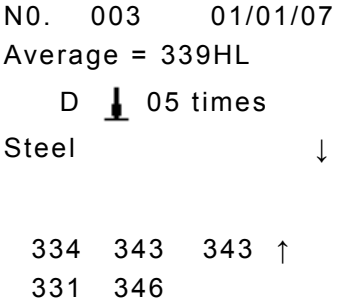
6.8 Browsing Memory Data Groups



Press **[▲]** or **[▼]** to see previous or next page.
Press **[**ESC**]** to exit browsing.



Press **[**ENTER**]** then press **[▲]** or **[▼]** to move the cursor to the line which you want to see details. Press **[**ENTER**]** to see details of that group.



Press **[▲]** or **[▼]** to browse details including average value, test set and each single value.
Press **[**ESC**]** to return to previous display.

6.9 System Set

At the main display interface, press key **[**MENU**]** enter the main menu.

Press **[▲]** or **[▼]** to move the cursor to **[**System Set**]** Menu.
Press **[**ENTER**]** to enter **[**System Set**]** menu.

Auto Save: Off
Auto Print: Off
Auto Delete: Off
Auto Trans.: Off
Key Sound: On
Warn. Sound: On
LCD Brightness
Time Date Set
Language

Press **[▲]** or **[▼]** to move the cursor to the item wanted.
Press **[**ENTER**]** to modify the setting directly or into corresponding screen.
Press **[**ESC**]** to exit.

[Auto Save**]** **[**Auto Delete**]** **[**Auto Trans**]** **[**Key Sound**]** **[**Warn. Sound**]** can be switched on or off.

When **[**Auto Save**]** is set to <On>, the data of the current group can automatically be stored after measuring and displaying the average value.
When **[**Auto Print**]** is set to <On>, the data of the current group can be automatically printed after measuring and displaying the average value.
When **[**Auto Delete**]** is set to <On>, according to the 3σ rule, gross error can automatically be canceled after having measured presetting average times or pressing end in advance. If data is canceled, supplementary measures are needed to reach presetting times.
When **[**Auto Trans.**]** is set to <On>, the value of the present group can be exported via the communication port after measuring and displaying the average value.
When **[**Key Sound**]** is set to <On>, the buzzer will emit a short sound each time a key is pressed.
When **[**Warn. Sound**]** is set to <On>, if the measured value exceeds the tolerance limit, has reached the presetting average times or is deleting data, the buzzer will emit a long sound.

6.9.1 LCD Brightness

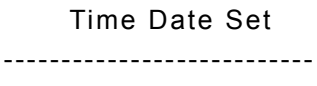
LCD Brightness

Bright : Press [▲]
Dark : Press [▼]

Press **[▲]** to enhance the brightness.
Press **[▼]** to weaken the brightness.
Press **[**ENTER**]** to confirm the modifying.
Press **[**ESC**]** to cancel the modfying.

6.9.2 Time Date

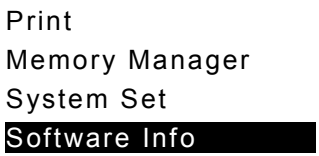
Present time and date is displayed as"M/D/Y H:M".



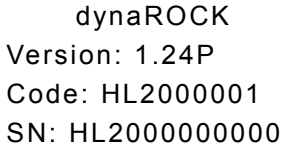
Press the (0-9) keys to modify the numbers. The cursor will move automatically from left to right after modification. Press **[**ENTER**]** to confirm modification. Press **[**ESC**]** to cancel modification and exit.

6.10 Software Information

At the main display interface, press **[**MENU**]** to enter the main menu.



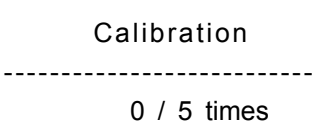
Press **[▲]** or **[▼]** to move the cursor to **[**Software Info**]**.
Press **[**ENTER**]** into **[**Software Info**]** screen.



This screen displays the information about the main unit and the firmware. The version, the Code and the SN would change according to the firmware.

6.11 System Calibration

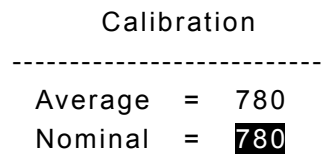
The tester and impact device must be calibrated using a hardness block before first time use, or after having not been used for a long time, or after having reset the system.



Press **[** ⏻ **]**, whilst also pressing **[**ENTER**]** to power-on the system. Then the software calibration screen shows as below.

Set the impact direction as **[** ⊥ **]** . Measure 5 points on the standard hardness block.

It would display the average value after measuring 5 times.



Press **[▲]** or **[▼]** to input the nominal value.
Press **[**ENTER**]** to confirm.
Press **[**ESC**]** to cancel this operation.
Range of adjustment: ±15HL.

6.12 EL Background Light

The background light makes it easier to work in dark conditions. Press **[☼]** to switch the background light on or off at any chosen moment after power-on.

6.13 Auto Power Off

- The instrument has the function of powering off automatically to save power.
- The system will automatically power down if there's no measuring or any other key operation within 5 minutes. With the exception of **[⏻]**, pressing any key can stop the twinkle of LCD screen and instantly stop the of power-off operation.
- If the battery voltage is too low, the screen will show < Battery Empty! >, then power off automatically.

6.14 Battery Replacement

Two AA size alkaline batteries are needed as the power source. After several hours' usage of the preset batteries, the battery symbol on the screen will be shown as  . The greater the dark area, the fuller are the batteries. When the battery capacity runs out, the battery symbol will be shown as  and will flash. The batteries then need to be replaced .

Refer to the sketch below during battery replacing. Please pay much attention to the polarity of the battery.

When the batteries are exhausted, the user should replace the batteries following the program below:

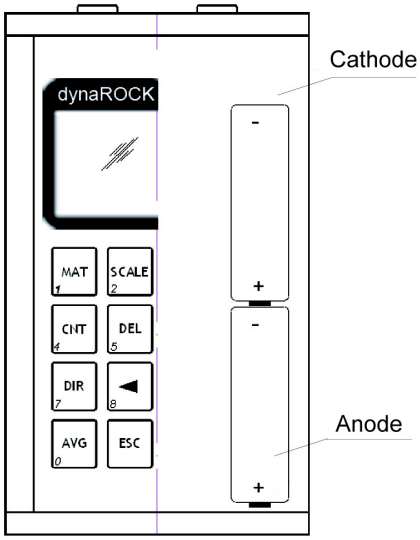


Figure 3:

- Power down the instrument.
- Take off the battery compartment's circular cover and remove the two batteries.
- Insert the new batteries into the instrument.
- Reset the battery cover.
- Power on the instrument to check.

6.14.1 Disposal Information

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.

6.15 Connection of Data Transmission Cable

Insert one of the transmission cable's connection plugs (optional parts) into the socket at the top left of main unit (see 1 in Figure 2), and then insert the other plug into the COM port in the back of computer.

7 Fault Analysis & Evacuation

Fault Appearance	Fault Analysis	Handling method
Failure power on	Battery exhaustion	Replace the batteries
	The batteries' positive /negative poles are upside-down	Position the batteries correctly

8 Servicing & Maintenance

8.1 Impact Device Servicing

After the impact device has been used 1000-2000 times, please use the nylon brush provided to clean the guide tube and impact body. When cleaning the guide tube, first unscrew the support ring, then take out the impact body, spiral the nylon brush in an anti-clockwise direction into the bottom of guide tube and take it out for five times, and then install the impact body and support ring.

- Release the impact body after use.
- Any lubricant is absolutely prohibited inside the impact device.

8.2 Normal Maintenance Program

When using standard Rockwell hardness block to test, if all errors are bigger than 2 HRC, it may be due to the invalidation of an impacted ball top caused by abrasion. Changing the spherical test tip or impact object should be considered.
if the hardness tester reveals some other abnormal phenomena, please do not dismantle or adjust any of the fixed assembled parts. Fill in and present the warranty card to us. The warranty service can be continued .

9 Calibration

Calibration needs to be carried out annually.

10 Notice of Transport and Storage Conditions

- Keep the instrument away from vibration, strong magnetic field, corrosive medium, dampness and dust. Storage in ordinary temperature.
- With original packing, transport is allowed on the third grade highway.

11 APPENDIX

Material	Scale	Impact device					
		D/DC	D+15	C	G	E	DL
Steel and cast steel	HRC	20 - 68.5	19.3 - 67.9	20.0 - 69.5		22.4 - 70.7	20.6 - 68.2
	HRB	38.4 - 99.6			47.7 - 99.9		37.0 - 99.9
	HRA	59.1 - 85.8				61.7 - 88.0	
	HB	127 - 651	80 - 638	80 - 683	90 - 646	83 - 663	81 - 646
	HV	83 - 976	80 - 937	80 - 996		84 - 1042	80 - 950
	HS	32.2 - 99.5	33.3 - 99.3	31.8 - 102.1		35.8 - 102.6	30.6 - 96.8
Cold work tool steel	HRC	20.4 - 67.1	19.8 - 68.2	20.7 - 68.2		22.6 - 70.2	
	HV	80 - 898	80 - 935	100 - 941		82 - 1009	
Stainless steel	HRB	46.5 - 101.7					
	HB	85 - 655					
	HV	85 - 802					
Grey cast iron	HRC						
	HB	93 - 334			92 - 326		
	HV						
Nodular cast iron	HRC						
	HB	131 - 387			127 - 364		
	HV						
Cast aluminium 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					
BRONZE (copper-aluminium/ tin alloys)	HB	60 - 290					
Wrought copper alloys	HB	45 - 315					

Table 3:

No.	Material	HLD	Strength σb(MPa)
1	Mild steel	350 - 522	374 - 780
2	High-Carbon steel	500 - 710	737 - 1670
3	Cr steel	500 - 730	707 - 1829
4	Cr-V steel	500 - 750	704 - 1980
5	Cr-Ni steel	500 - 750	763 - 2007
6	Cr-Mo steel	500 - 738	721 - 1875
7	Cr-Ni-Mo steel	540 - 738	844 - 1933
8	Cr-Mn-Si steel	500 - 750	755 - 1993
9	Super strength steel	630 - 800	1180 - 2652
10	Stainless steel	500 - 710	703 - 1676

Table 4:

Type of impact device	DC(D)/ DL	D+15	C	G	E
Impacting energy Mass of impact body	11mJ 5.5g/7.2 g	11mJ 7.8g	2.7mJ 3.0g	90mJ 20.0g	11mJ 5.5g
Test tip hardness: Dia. Test tip: Material of test tip:	1600HV 3mm Tungsten carbide	1600HV 3mm Tungsten carbide	1600HV 3mm Tungsten carbide	1600HV 5mm Tungsten carbide	5000HV 3mm synthetic diamond
Impact device diameter: Impact device length: Impact device weight:	20mm 86(147)/ 75mm 50g	20mm 162mm 80g	20mm 141mm 75g	30mm 254mm 250g	20mm 155mm 80g
Max. hardness of sample	940HV	940HV	1000HV	650HB	1200HV
Mean roughness value of sample surface Ra:	1.6μm	1.6μm	0.4μm	6.3μm	1.6μm

Type of impact device		DC(D)/ DL	D+15	C	G	E
Min. weight of sample: Measure directly Need support firmly Need coupling tightly		>5kg 2 - 5kg 0.05 - 2kg	>5kg 2 - 5kg 0.05 – 2kg	>1.5kg 0.5 - 1.5kg 0.02 - 0.5kg	>15kg 5 - 15kg 0.5 – 5kg	>5kg 2 - 5kg 0.05 – 2kg
Min. thickness of sample Coupling tightly Min. layer thickness for surface hardening		5mm ≥0.8mm	5mm ≥0.8mm	1mm ≥0.2mm	10mm ≥1.2mm	5mm ≥0.8mm
Size of tip indentation						
Hard-ness 300HV	Indentation diameter Depth of indentation	0.54mm 24µm	0.54mm 24µm	0.38mm 12µm	1.03mm 53µm	0.54mm 24µm
Hard-ness 600HV	Indentation diameter Depth of indentation	0.54mm 17µm	0.54mm 17µm	0.32mm 8µm	0.90mm 41µm	0.54mm 17µm
Hardn-ess 800HV	Indentation diameter Depth of indentation	0.35mm 10µm	0.35mm 10µm	0.35mm 7µm	-- --	0.35mm 10µm
Available type of impact device		DC: Test hole or hollow cylindrical; DL:Test slender narrow groove or hole	D+15: Test groove or re-entrant surface	C: Test small,light, thin parts and surface of hardened layer	G: Test large, thick, heavy and rough surface steel	E: Test super high hardness material

Table 5:

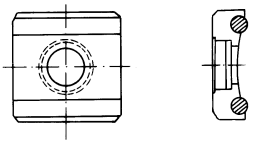
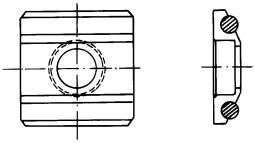
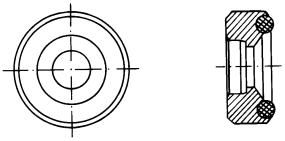
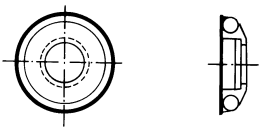
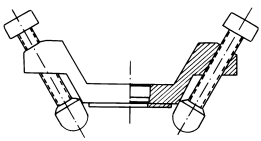
No.	Type	Sketch of non-conventional Supporting ring	Remarks
1	Z10-15		For testing cylindrical outside surface R10 - R15
2	Z14.5-30		For testing cylindrical outside surface R14.5 - R30
3	Z25-50		For testing cylindrical outside surface R25 - R50
4	HZ11-13		For testing cylindrical inside surface R11 - R13
5	HZ12.5-17		For testing cylindrical inside surface R12.5 - R17
6	HZ16.5-30		For testing cylindrical inside surface R16.5 - R30
7	K10-15		For testing spherical outside surface SR10 - SR15
8	K14.5-30		For testing spherical outside surface SR14.5 - SR30
9	HK11-13		For testing spherical inside surface SR11 - SR13
10	HK12.5-17		For testing spherical inside surface SR12.5 - SR17
11	HK16.5-30		For testing spherical inside surface SR16.5 - SR30
12	UN		For testing cylindrical outside surface,radius adjustable R10 - ∞

Table 6:

BAQ GmbH
Bienroder Weg 53
38108 Braunschweig
Germany
www.BAQ.de
Tel.: +49 531 21 547-0
Fax: +49 531 21 547-20
eMail: baq@baq.de