MITECH LEEB HARDNESS TESTER MH600

User's Manual

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1 Introduction

This hardness tester is designed for testing metallic materials, the hardness of which ranges from very low to very high values. Hardness testing can be performed directly on-site and in any position. Typical applications are large, heavy workpieces which could only be transported to a hardness testing machine in a laboratory with great difficulty. It is especially suitable for applications in which standard indentation hardness testing is either not feasible or not economical.
This hardness tester comprises an indicating device and an impact device. It is based on the rebound hardness testing method according to Leeb. It is for testing the hardness of all material surfaces over a large range of hardness quickly and independently.

1.1 Features of the instrument

The instrument represents a user-friendly microprocessor-controlled measuring system characterized by the following benefits:

Wide measuring range
Based on the principle of Leeb rebound testing method, it can measure the hardness value of all metallic materials. It can also measure the tensile strength of many metallic materials.

Impact device
Support seven types of impact device. Type of impact device automatically identified.

Impact direction correction
Impact direction automatically detected and corrected (after base calibration, except type G) , high measuring accuracy in every impact direction, convenient measurement in any position.

Scale
Integrated conversion of the measured values to other popular hardness scales, e.g. HRC (Rockwell), HRA, HRB, HV (Vickers), HB (Brinell), HS (Shore), HL (Leeb), Rm (Tensile strength for steel).

Calibration
Base calibration function and multi-point calibration function.

HLX conversion function
HLX conversion function to convert HLD values to HLC, HLG, HLDL and HLD+15, and vice versa.

Tolerance limit
Upper and lower limit can be set. It will alarm automatically when the test value exceeding the limit.

Display
Color TFT display (320×240 TFT LCD) with adjustable backlight, allow the user to work at worksites with low visibility.

Memory
Integrated memory – Non-volatile, 500 series of measured values including each individual measured value, mean value, testing date, impact direction, impact times, material and hardness scale etc..

Power saving
Two AA size alkaline batteries as the power source. Continuous operating period of no less than 100 hours (default brightness setting). Display Standby and Auto Power Off functions to save power.

Real time clock
The instrument clock keeps running tracking the time.

Communication
USB communication port. Online transfer of the measured data to PC or laptop via USB.

Robust design
Robust design allow the user to work at dusty worksites .

1.2 Technical specifications

The error and repeatability of the test value see the following table.

Table 1-1

No.	Impact Device	Hardness value of the test block	Measuring accuracy	Measuring Repeatability
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

- Measuring range：170 to 960 HLD
- Impact direction：360°. Auto detecting direction capability.
- Built in conversion table from(to) HLD to(from) HLC、HLG、HLDL、HLD+15
- Hardness Scale：HL、HB、HRB、HRC、HRA、HV、HS
- Display：color TFT LCD，320×240 dots, adjustable backlight
- Display of mean value, minimum value and maximum value.
- Integrated data memory： 500 measurement series.
- Battery: two AA size, 1.5 Volt alkaline batteries
- Continuous operating period：about 100 hours（with default brightness）
- Communication：USB1.1; PC software is provided to transfer data between the instrument and PC.
- Multiple display languages (English, Chinese, etc.).
- Weight: Approximately 220g.
- Dimensions：150mm×76mm×38mm.

1.3 Standards and regulations applied

ASTM A956 (2006)、CNAL T0299 (2008)、JIS B7731 (2000)、DIN 50156 (2007)、DGZfP Guideline MC 1 (2008)、VDI / VDE Guideline 2616 Paper 1 (2002)、ISO 18625 (2003)、GB/T 17394 (1998)、JB/T 9378 (2001)、JJG 747 (1999).

1.4 Operating conditions

Operating temperature： -10℃～＋50℃;
Storage temperature：-30℃～＋60℃;
Humidity: ≤90％;
The surrounding environment should avoid of vibration, strong magnetic field, corrosive medium and heavy dust.

1.5 Application examples

- Hardness tests on already assembled machines or steel and cast constructions; e.g. on heavy and large work pieces or on permanently installed system parts.
- Rapid testing at many measuring points to examine the hardness over large areas.
- Control measurement for rapid determination of a specific thermal treatment result; e.g. annealed or quenched and tempered conditions.
- Testing of workpieces for which the test indentation should be as small as possible on sharp edges;

e.g. on rolls or grinded surfaces of machine parts.
- Automatic hardness tests of mass-produced parts during manufacturing operation; e.g. automotive industry.

1.6 Scope of delivery

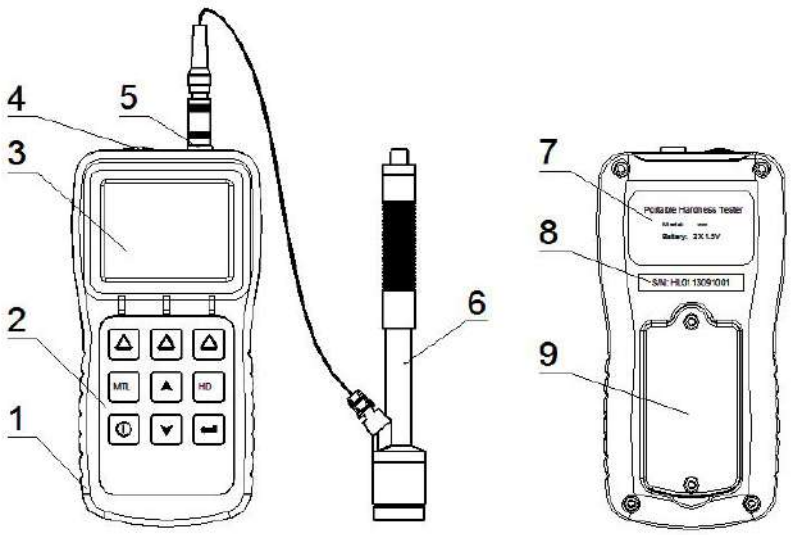
Table 1-2

	No.	Item	Qty	Remarks
Base package	1	The main unit	1	
	2	Impact device D	1	With cable
	3	Test block	1	
	4	Cleaning brush(I)	1	
	5	Small supporting ring	1	
	6	Battery	2	AA Size, Alkaline
	7	Documents	1	Operating manual, Certificate
	8	Carry case	1	
	9	Datapro Software	1	
	10	USB Cable	1	miniUSB-B to USB-A
Optional parts	11	Cleaning brush(II)		For use with G type impact device
	12	Other type of impact devices and support rings		Refer to Table 3 and Table 4 in the appendix.

Note:
Test block – It is necessary to regularly conduct 3 to 10 test impacts on a reference hardness object to verify the correct operation of the instrument. Various test blocks are available depending on the users' hardness requirements. For added convenience, the test blocks also indicate the reference hardness value in different hardness scales.
Support rings – Leeb Rebound testers only work correctly when the impact body is held at a proper distance from the test surface during impact. The wide range of support rings permits testing on a great variety of part geometries, i.e. flat surfaces, concave or convex cylindrical surfaces, spherical test surfaces.

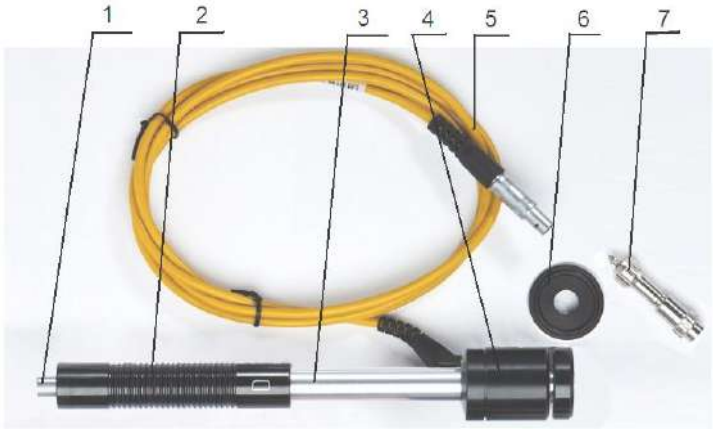
2 Product Feature

2.1 Structure feature



1,The main unit 2,Keypad 3,LCD display 4,USB port
5,Socket of impact device 6,Impact device 7,Label
8, Serial Number 9,Battery compartment

2.2 Impact device D



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

During measurement with this hardness tester, an impact body with a hard tip is impacted by spring energy against the sample to be measured and then rebounds. During the impact, a permanent magnet integrated in the impact body passed through a coil in which voltage is induced by the forwards and backwards movement. This voltage is proportional to the velocities. The impact and rebound velocity is measured when the impact body tip is approx. 1mm away from the sample to be measured. The measuring signal is converted to the hardness value by the unit electronics, shown in the display and stored in the unit memory (if set to strore).

2.3 Other impact devices

DC DL C D+15 E G

The main unit can be combined with any impact device to accommodate specific needs. Special impact devices are available for use in confined spaces, with special component geometry or surface finish.

2.4 Leeb rebound principle for hardness testing

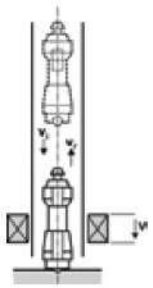
This hardness tester operates according to the Leeb principle, in which the hardness value is calculated from comparing the energy of a test body before and after impacting on a sample.

The energy quotient is quoted in the hardness unit HL and is calculated from comparing the impact and rebound velocities of the impact body. It rebounds faster from harder samples than from softer ones, resulting in a greater energy quotient which is defined as 1000×Vr/ Vi.

$$HL=1000\times Vr/ Vi$$

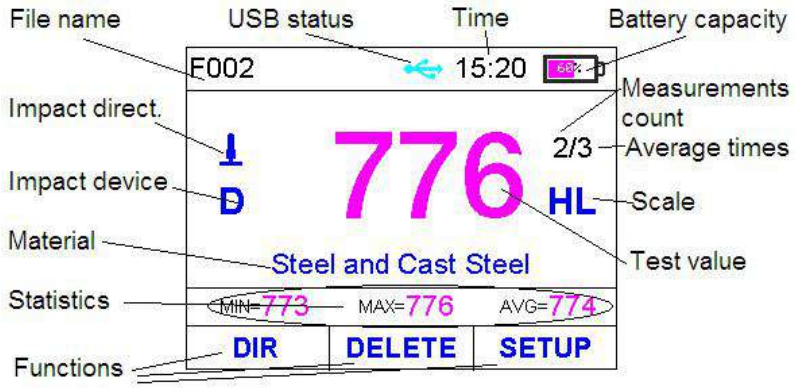
Where,

HL— Leeb hardness value
Vr — Rebound velocity of the impact body
Vi — Impact velocity of the impact body



2.5 Screen display

Below is the main screen of the main unit：



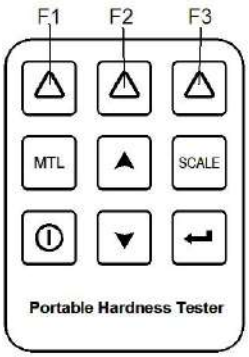
- **Material** – Selected material.
- **Impact device** – Type of impact device connected to the main unit
- **Impact direction** – Impact direction setting (“AUTO” when automatically detecting the direction and auto correction); Or detected impact direction after impact in auto direction mode.
- **File name** – Next file name to store the measurement series.
- **USB status** – Appears when the USB connection succeeds.
- **Time** – Real time clock of the instrument system in HH:MM format.
- **Battery capacity** – Shows the rest capacity of the batteries.
- **Measurements count** – Number of measurements in a series.
- **Average times** – Set number of measurements per series.
- **Test value** – Shows last individual measured value before the test series closes; Or shows the average measured value when the test series closes.
- **Scale** – Hardness/Strength scale to display the test value.
- **Statistics** – Shows minimum, maximum and average value of the test series.
- **Functions** – Functions that can be executed. Functions are programmed and assigned to the function keys F1 to F3. Note that the assignment of the function keys changes depending on the current dialog/menu.

Testing operation could be carried out under this main screen. After each impact, it will display a singled measured value; impact count plus one; the buzzer would alert a long howl if the measured value is not within the tolerance limit. When reaching the average times, the buzzer will alert a long howl. After 1 to 2 seconds, the buzzer will alert a short howl, and display the average measured value.

2.6 Keypad

The instrument is designed to give the user quick access to all of the instrument’s functions. Its easy-to-use menu system allows any function to be accessed with several key presses.

Function keys F1, F2 and F3.
Up arrow key - Navigate up; Increase values
Down arrow key - Navigate down; Decrease values
Selects and Confirms
Turn the main unit on or off; Cancel or close.
Selection of the test material.
Selection of the hardness scale. Displayed hardness scale will affect all measurements in the current measurement series. Changing the displayed hardness scale does not change the raw data as measured in HL.



2.7 Measuring conditions

In order to avoid erroneous measurements:

- Make sure that no heat or surface deformations occur at the testing point during the testing process.
- Ensure the surface of the workpiece is clean, smooth and dry.
- Ensure that the specimen is immobile and not subject to vibrations during the test (due to the dynamic functioning of the hardness testing method). Thin parts must be specially fastened.
- Use samples with large dimensions and enough mass if possible. Special measures must be taken for specimens that weigh less than 5 kg.
- Recommendation: Carry out at least 3 to 5 impacts at spaces of at least 3 to 5 mm at each measuring point and use the average of the individual values.
- Do not carry out an impact in an area that has already been deformed by another impact.
- When preparing the surface, please observe that the condition of the material may be affected (e.g. due to heating or cold working). As a consequence, the hardness is also influenced. If the surface is inadequately prepared, the measuring results can be affected. Excessive surface roughness results in lower HL values (the true hardness is greater than indicated) and broad variations of individual measurements. Cold-worked surfaces produce excessively large HL values (the actual hardness is less than measured).

3 Startup

3.1 Power supply

Two AA size alkaline batteries are needed as the power supply.
The battery compartment is situated at the instrument back. The cover is fastened with two screws. To insert the batteries:

- Loosen the two screws of the battery cover.
- Lift the cover off upward.
- Insert the batteries into the battery compartment.
- Close the battery compartment and fasten the screws.
- Turn on the instrument to make sure the battery is installed correctly and firmly.

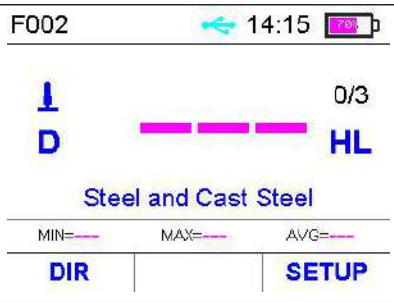
3.2 Connecting the instruments

To prepare the instrument for operation, you have to connect an impact device to it. The instrument is available with the Lemo socket connectors.
When connecting an impact device to the instrument, it's not only important that the physical connection be properly made. It's also important that the instrument is properly configured to work with the installed impact device.

3.3 Starting the instrument

To start the instrument, press down ⏻ key until display activates. While the device is booting a splash screen, the serial number of the unit, the installed software version, the date and time of the system appear on the display.

The start display of the instrument appears as right figure. Press F1 key to change to a different language. Press F3 key to skip the booting check process and enter the measure mode immediately.	

The instrument carries out a self-check and then switches over to the measure mode automatically if there is no key operation. The instrument is now ready for the first measurement.	

The instrument will automatically reload last settings. It has a special memory that retains all of its settings even when the power is off.
The type of connected impact device will be detected automatically if the impact device setting is “AUTO”. User should check if the type of the impact device is correct. If the type of the impact device is incorrect, change the setting or check the connection.
Probe specific parameters must be measured again if the impact body has been changed, or hardness test shows deviations greater than ±6 HLD from the nominal value. Recalibration of the probe is recommended if: the impact device has been cleaned; the impact device has not been used for a longer time; or particular high accuracy is required. Refer to 4.3 for details.
To shut off the instrument, keep pressing down ⏻ key until shutting down message appears.
Note:The instrument will shut off automatically if the battery capacity level is too low.

3.4 Configuration of the standby settings

To save battery power, the device supports the following power states:

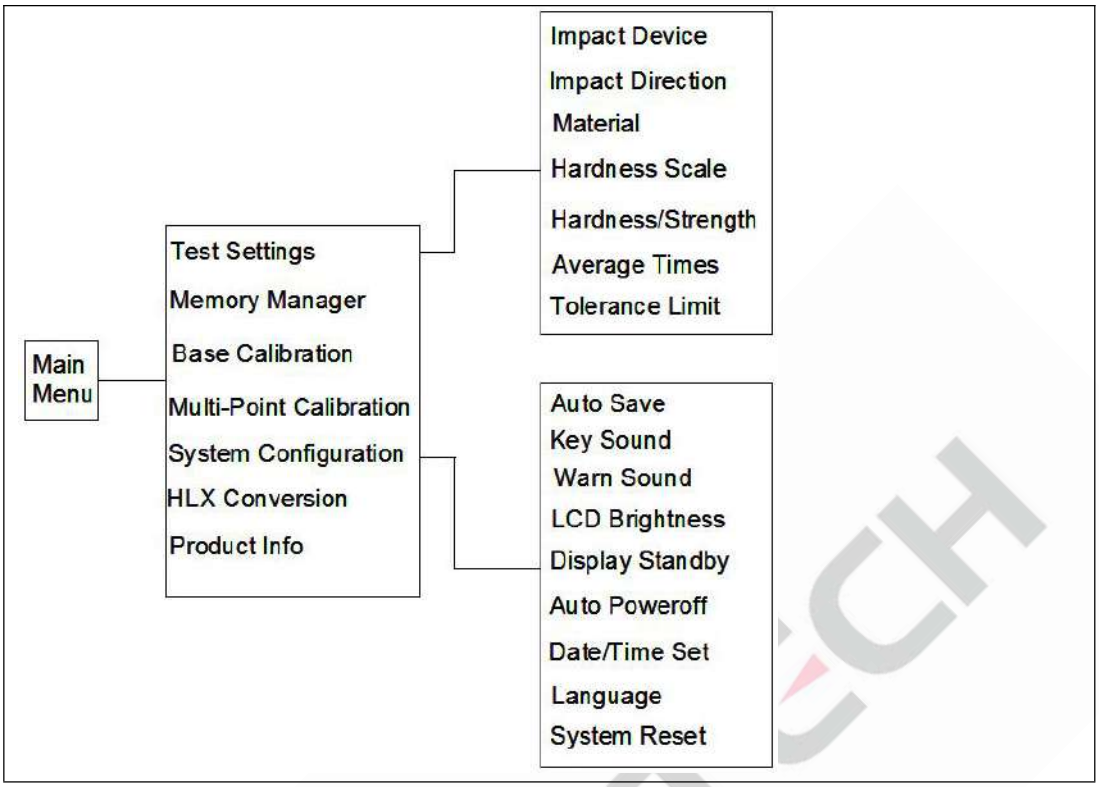
- **Run state** – The main unit is running at full frequency
- **Standby state** – After 5 seconds (default setting) the brightness of the LCD display is tuned to a low level and the CPU is running at reduced frequency. This has no effects on the data or the memories. Pressing any key or performing a measurement sets the unit back to run state and the brightness is tuned back.
- **Power off state** – After 2 minutes (default setting) the instrument changes from standby state to power off state. The main unit and the display is switched off and consumes almost no energy. Pressing any key will stop the unit entering power off state while it prompts out “Idle Timeout!” and return back to run state.

The change from run state to standby state is controlled by display standby delay setting. The time delay can be configured by the user in the Display Standby Delay dialog box. The main unit can be reset to run state by any user activity while in standby state.

4 Settings

On the main screen, press F3 key to open the main menu. Navigate with arrow keys through the menu items.

Structure of the menus:



Note: If a specific menu item is disabled (appears in a different color), the high light cursor will skip that item while navigating.

4.1 Test settings

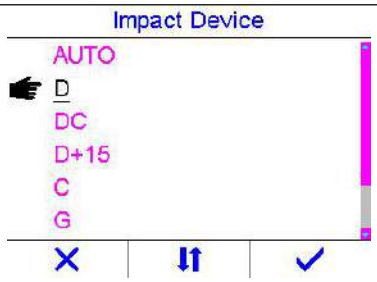
Press arrow keys or F2 key to navigate up and down to highlight the desired item.
Press ↵ or F3 key to change the setting or open the setting dialog.
Press ⓘ or F1 key to return to the main menu.

Preselected parameters of test setting:

- Impact device – Automatically identified.
- Impact direction – Automatically detected and corrected.
- Material – Steel and cast steel
- Hardness scale – HLD (if available for connected impact device type)
- Average times – three

4.1.1 Impact device setting

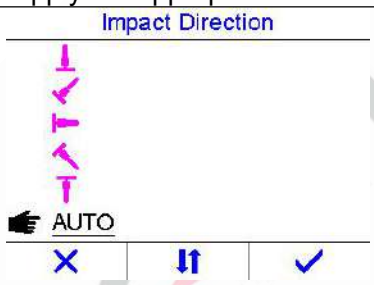
The impact device setting can be fixed to a specific type of impact device depending on the one connected to the main unit. As an alternative, AUTO item can also be selected to identify the type of the impact device automatically.

Press arrow keys or F2 key to navigate up and down to highlight the desired item. Press ↵ or F3 key to confirm the selection. Press ⓘ key to cancel the change and close current dialog box.	

Make sure the selected or the automatically identified impacted device agrees with the connected one. Incorrect type of the impact device will lead to erroneous result.

4.1.2 Impact direction setting

The instrument offers two methods for correction for non-vertical impact direction: automatic and manual. With manual correction the user has to specify the actual impact direction. In automatic mode the instrument will find out the impact direction itself and apply the appropriate correction.

Press arrow keys or F2 key to navigate to the desired item. Press ↵ or F3 key to confirm the selection. Press ⓘ key to cancel the change and close current dialog box.	

If AUTO item is selected, the impact direction will be detected according to the rebound signal of the impact body and the measurement value will be corrected automatically by the main unit.

Note:

- AUTO item is disabled for G type of the impact device.
- The main unit detects the impact direction correctly only after base calibration.
- If only vertical down measurements are performed, disabling AUTO mode is preferable.

4.1.3 Material setting

Press arrow keys or F2 key to navigate to the desired material. Press ↵ or F3 key to confirm the selection. Press ⓘ key to cancel the change and close current dialog box.	
Note: ➢ *Material selection will affect all measurements in the current measurement series.* ➢ *Hardness scale recovers to HL automatically when material selection is changed. So please select material before setting hardness scale.*	

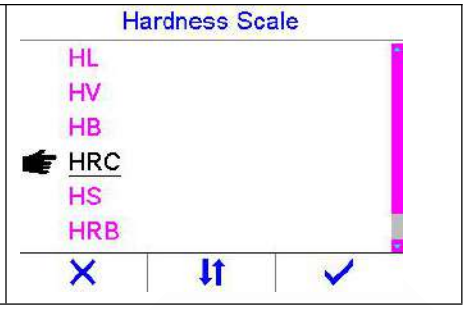
When Hardness/Strength is set to hardness, the following materials are available: Steel and Cast Steel、Cold Work Tool Steel、Stainless Steel、Gray Cast Iron、Nodular Cast Iron、Cast Aluminum Alloys、Copper-Zinc Alloys、Copper-Aluminum Alloys、Wrought Copper and Wrought Steel.

When Hardness/Strength is set to strength, the following materials are available: 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.

4.1.4 Hardness scale setting

Metal hardness can be displayed in different hardness scales: HL(Leeb), HRC (Rockwell C), HB (Brinell), HV(Vickers), HS, HRA and HRB. The instrument enables measurements to be rapidly taken and displayed in any chosen hardness scale.

The hardness scale can be selected with the arrow keys, or by pressing F2 key.
Press ↵ or F3 key to confirm the selection.
Press ⓘ key to cancel the change and close current dialog box.

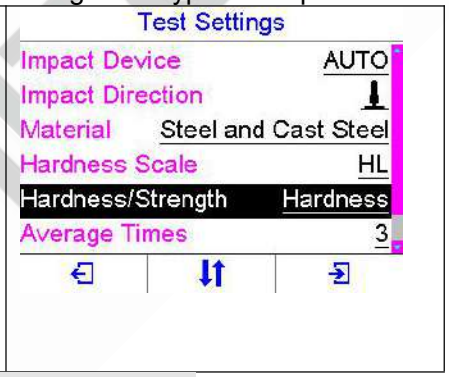


Dynamic HL values are converted to equivalent static hardness values, e.g. HV, HB and HRC, with a certain conversion scattering.
Hardness scale conversions are material specific, caused by the fact, that there is no clear physical relationship between the various methods.
Note: For some specific materials, the hardness value can't be displayed in all hardness scales. If a hardness scale is not supported for the selected material, that hardness scale item will be disabled automatically and can't be selected. The hardness scale is reset to HL automatically after changing the material. So select material before changing the hardness scale.

4.1.5 Hardness/Strength setting

The instrument has an feature that allows the user to convert hardness readings into tensile strength.
Note: Only impact device D and DC have the function of strength test option. You can not change the Hardness/Strength setting (fixed to hardness) when using other types of impact device.

Press ↵ or F3 key to select between hardness and strength while the Hardness/Strength item is high-lightened.
The Hardness/Strength setting would be set to hardness automatically after replacing the impact device whether the setting is hardness or not before.



If the Hardness/Strength setting is hardness, the Hardness Scale item will be disabled and can not be changed.

4.1.6 Average times setting

Average times can be adjusted from 1 to 32. The measurement series will be closed and the average test value will be displayed when the measurement series reaches Average times setting.

Press arrow keys to increase or decrease the value.
Press ↵ or F3 key to confirm the setting.
Press ⓘ key to cancel the change and close current dialog box.

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4.1.7 Tolerance limit setting

Setting the limits for a measurement series. Values outside the limits are displayed with a "↑" or "↓".

Press F1 or F3 key to move the highlight cursor; Press arrow keys to increase/decrease the values. Press ↵ or F3 key to confirm the setting. Press ⓘ key to cancel the change and close current dialog box.	

Note:

- The setting limit cannot exceeds the measure range.
- If the lower limit is larger than the upper limit the instrument will prompt an error message.

4.2 Memory manager

Memory Manager is used to manage (view, delete) the internal data storage. On the memory manager dialog box, it shows each stored file name, mean value of the each test series, and test time of each series.

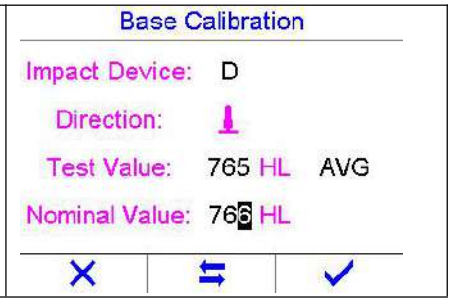
Press arrow keys to navigate to the desired line Press F1 key to delete all test series. Press F2 key to delete the high-lightened test series. Press F3 or ↵ key to view the content of the high-lightened test series. Press ⓘ key to close the dialog box.	
On the view data dialog box (see right), it shows the series file name, the test time, material, impact device, impact direction, average test value and all individual test value. Press arrow keys to navigate up and down. Press F3, ↵ or ⓘ key to close the dialog box.	

4.3 Base calibration (Impact device calibration)

Base calibration is based on a standard conversion function H_{std} (L) and shifts this vertically so that the conversion of the specified HL value L1 coincides with the known converted value H1.

Base calibration is typically used if only one workpiece with known hardness in the required scale is available or all available reference pieces have hardness values that are grouped closely together. The workpieces to be measured are made from the same materials and their hardness differs only slightly from the reference hardness.

Procedure of the base calibration：

➢ Open the base calibration dialog box. ➢ Check if the type of the impact device is correct. ➢ Perform five vertical down measurements on a reference block. ➢ Use F2 and arrow keys to increase/decrease the nominal value. ➢ To save the new calibration results, press the F3 key. Or press F1 key to cancel the calibration and exit.	

The new calibration results are saved to the main unit and will be used automatically in the following test.

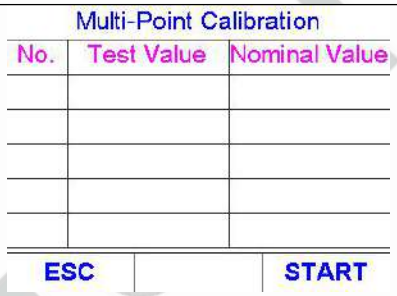
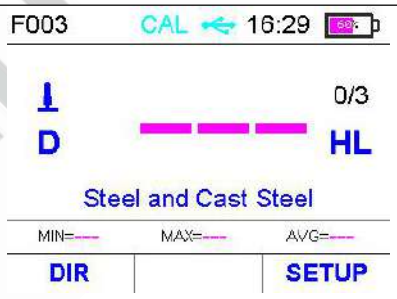
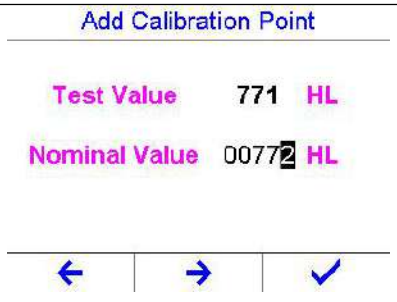
Note:

Base calibration for a impact device must be carried out before enabling auto detecting the

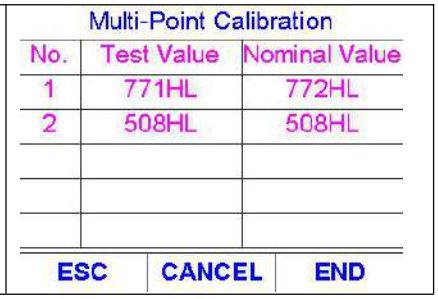
impact direction of that impact device.
The calibration results are stored in the EEPROM of the main unit and the stored calibration results will not be lost until next calibration or system reset.

4.4 Multi-point calibration

This instrument provides conversion curves into standard hardness scales for a series of materials. For special solutions it is possible for the user to correct conversion functions if conversions display systematic deviations.
Multi-point calibration uses a standard conversion function H_{std} (L) and adds a straight line, which is determined by at least two reference test points using least squares approximation method, so that the resulting conversion function H(L) coincides all the reference points.
Multi-point calibration is typically used if at least two workpieces with known and significantly distinct hardness values in the required scale are available. The workpieces to be measured are made from the same material and are neither significantly harder than the hardest reference piece nor significantly softer than the reference piece.
Before starting the multi-point calibration process, prepare 2 to 5 reference blocks with known hardness value calibrated using other test method. The reference blocks should conform to the measuring conditions of this instrument. Procedure of the multi-point calibration：

➢ Step 1, open multi-point calibration dialog box. ➢ Step 2, Press ↵ or F3 key to start the calibration process. The display will be switched back to the main screen automatically when the multi-point calibration process starts.	
On the main screen, please note that “CAL” characters appear on top of the screen indicating calibration in process. ➢ Step 3, Configure the impact device, material selection and hardness scale settings.	
➢ Step 4, Test the hardness value of the first reference block. When the test series closes, “CAL” command will appear on bottom-left of the main screen. Then continue: ➢ Step 5, Press F1 key to add a new calibration point to the calibration points series. The Add Calibration Point dialog box will be opened automatically.	
On the Add Calibration Point dialog box, the average test value is displayed. ➢ Step 6, Input the nominal value of this reference block by pressing F1, F2 and arrow keys. ➢ Step 7, Press ↵ or F3 key to complete the addition of the new calibration point. Or press ⓘ key to discard this new calibration point and close the dialog box.	

- Repeat step 4 to step 7 to test the other reference blocks prepared.
- Re-open the multi-point calibration dialog box after testing all the reference blocks. Note that all the calibration points are listed on the screen with their test values and nominal values.



Press ↵ or F3 key to end the multi-point calibration process and save the calibration result to its non-volatile memory. The new calibration results will replace the old ones and will be used automatically in the following test.

Or press ⓘ or F1 key to discard the calibration result and return to the main screen.

Note: The stored calibration results will not be lost until next calibration or system reset.

4.5 System configuration

Press arrow keys or F2 key to navigate up and down.

Press ↵ or F3 key to change current setting or open the setting dialog box.

Press ⓘ or F1 key to return to the main menu.

Preselected parameters of system configuration:

- Auto save – Disabled
- Key sound – Enabled
- Warn sound – Enabled
- LCD brightness – 20% of the full brightness
- Display standby – After 5 seconds of idleness (no operating)
- Auto power off – After 2 minutes of idleness (no operating)

4.5.1 Auto save

When Auto Save is set to “On”, the measurement series will be automatically stored when the set number of values (average times) for a measurement series has been reached.
When Auto Save is set to “Off”, the measurement series will not be stored automatically.

4.5.2 Key sound

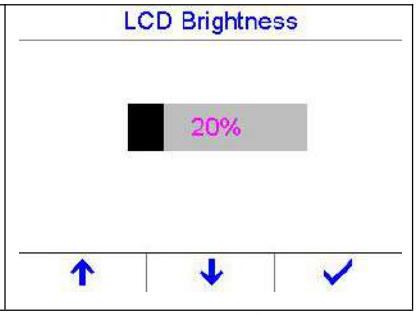
Key sound can be configured to on or off. When the key sound is set to on, the buzzer inside the main unit would make a short audible alarm while press the key each time.

4.5.3 Warning sound

Warning sound can be configured to on or off. If the warning sound is set to on, the buzzer inside the main unit would make a long audible alarm if the measured value exceeds the tolerance limit, reaching the average times, or the main unit gives out some operation warnings.

4.5.4 LCD brightness

LCD background illumination can be adjusted.

The setting can be changed by scrolling with F1 (increase) and F2 (decrease) keys, or by pressing arrow keys. Press ↵ or F3 key to confirm the setting. Press ⓘ key to cancel the change and close the dialog box.	

The instrument consumes less current in lower brightness and consequently increases the operating time.

Note: For saving power, lower down the LCD brightness in good light environment.

4.5.5 Configuration of the display standby settings

Standby state lower down the LCD brightness and puts the CPU in a power conserving mode. The change from run state to standby state is controlled by the setting of the display standby delay.

See right figure of Display Standby Delay dialog box for the items of the settings. Press arrow keys or F2 key to select the desired item. Selecting “Disable” item will forbid the main unit switching into standby state.	

The main unit goes into standby state after a period of time as selected. Trigger the impact or press any key to reactivate the main unit from standby state.

4.5.6 Configuration of the auto power off settings

The change from standby state to power off state is controlled by the setting of auto poweroff delay.

The time delay can be configured by the user in the auto poweroff delay dialog box. Press arrow keys or F2 key to select the desired item. Selecting the “Disable” item will forbid the main unit switching automatically into power off state.	

Note: If the voltage of the battery is too low, the LCD screen will show “Battery Exhausted!”, then power off automatically.

4.5.7 Date and time set

For a correct documentation you should always make sure that you are using the correct date and time setting. Open the system date&time dialog box to set date and time of the instrument system.
The format for date: Year-Month-Date
The format for time: Hour–Minute- Second

Use F1 and F2 keys to move the cursor. Use arrow keys to increase/decrease the values; Press ↵ or F3 key to confirm the setting. Press ⓘ key to cancel the setting change and close the dialog box.	

Once set, the internal clock of the instrument will maintain the current date and time.

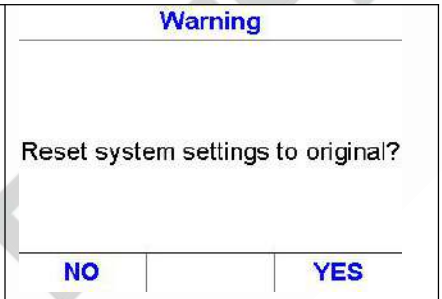
4.5.8 Language selection

Language of the application software can be selected.

Use the arrow keys and F2 key to select the operating language. Press ↵ or F3 key to confirm the selection. Press ⓘ key to cancel the language change and close the dialog box. *Note: User can also change the operating language on the booting screen during startup.*	

4.5.9 System reset

In case the instrument can no longer be operated, or you need to make a basic initialization (factory setting), you can reset the instrument to original.
The instrument can be reset by the System Reset function. All the stored data inside the main unit and user calibration will be cleared during system reset. And the instrument settings will be reset to default.
To reset the instrument:

➢ Activate the System Reset function. Then you will see right dialog. ➢ Press F3 key to confirm the reset operation. Or press F1 key to cancel the reset operation. NOTE: ➢ The effects of resetting the instrument may not be reversed. ➢ No key action should be performed during resetting process.	

4.6 HLX conversion function

HLX conversion function helps to convert HLD values to HLC, HLG, HLDL and HLD+15, and vice versa.

➢ Open the HLX Conversion dialog box. See right dialog. ➢ Press SCALE key to select the conversion function, e.g. HLD->HLC (HLD values to HLC values conversion). ➢ Modify the input value using F1, F2 and arrow keys. ➢ Press F3 to see the converted result value. Press ⓘ key to close the HLX conversion dialog box at any time.	

Note: The input value is limited by the conversion range. So it is not possible to input a value exceeding the conversion range.

4.7 Product information

Information concerning the instrument model, the software version and the serial number of the main unit is displayed. Press ↵, ⓘ, F1 or F3 key to close the dialog box.	

4.8 Replace the batteries

When the battery capacity runs out, the batteries should be replaced. The user should replace the batteries following the program below:

- Turn off the instrument.
- Take off the battery compartment cover and take out the batteries.
- Insert the new batteries.
- Fasten the battery cover.
- Turn on the instrument to check.

Warning:

- **Please pay much attention to the polarity of the battery during battery replacement.**
- **Do not cast the battery into fire, disassemble or heat the battery. Otherwise battery leakage, fire or even explosion may occur.**

Please take out the batteries when not working during a long period of time.

4.9 Communication

The instrument is equipped with a USB port on upper left of the instrument.
The PC can be connected with the instrument via the USB cable.

- Lift the rubber flaps to uncover the connection port.
- Insert the mini-USB end of the USB cable into the USB socket on the upside of main body.
- Insert the other end into the USB port of the computer.

After installing the DataPro software and the USB driver, you can download the stored test data from the tester.
The DataPro software helps manage and format stored data for high-speed transfer to the PC. Data can be printed or easily copied and pasted into word processing files and spreadsheets for further reporting needs. New features include live screen capture mode and database tracking. Detailed information of the communication software and its usage refer to the software manual.

5 Operation

Caution: Insufficient preparation of the test procedure may damage to the unit and/or the sample to be measured.
Before each test procedure:

- Clean if necessary.
- Carry out performance check.
- Check or change settings (impact device, impact direction, materials, scales, etc.).

5.1 Preparation of the sample

Preparation for sample surface should conform to the relative requirement in the Appendix Table 3.

5.1.1 Weight and thickness of the test piece

Place specimens under 5kg on a solid base so that they cannot be moved or oscillate as a result of the impact. Firmly couple specimens that weigh between 0.1-2kg to an immovable base, e.g. a heavy base plate.
Despite the low mass of the impact body and low impact energy, a relatively large impact force of short duration is generated when the impact body hits the measuring surface.

Impact device types	Classification of samples			Max. Imp act force
	heavy	Medium-weight	Light-weight	
D/DC, DL, E	More than 5.0 kg	2.0 – 5.0 kg	0.05 – 2.0 kg	900N≈90kgf
G	More than 15.0 kg	5.0 – 15.0 kg	0.50 – 5.0 kg	2500N≈250kgf
C	More than 1.5 kg	0.5 - 1.5 kg	0.02 – 0.5 kg	500N≈50kgf

For heavy samples of a compact shape, no particular precautions are necessary. Smaller and lighter samples or workpieces yield or flex under this force, producing HL values which are too small and of excessively large variation. Even with big or heavy workpieces, it is possible for thin wall regions or thinner protruding parts to yield upon impact. Depending on the frequency of the resulting yielding action,

the measured HL value may be too small or too large.

In many situations, potential problems can be checked in the following manner:

- Medium-weight samples and also heavier samples with protruding parts or thin walls should be placed on a solid support in such a manner that they do not move or flex during the test impact.
- Light-weight samples should be coupled with a non-yielding support such as a heavy base plate to guarantee that they are rigid. Clamping in a vice is of no value, since the samples become exposed to stress and because complete rigidity is never attained, resulting in measured HL values which would be too high and show excessive variations.

Note: Thin areas or parts can oscillate slightly upon impact, even in the case of heavy or medium-weight workpieces. This can lead to incorrect values and a clanking noise when an impact is carried out.

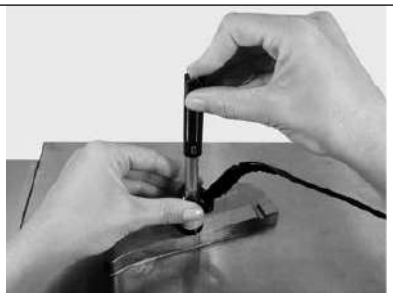
5.1.2 Coupling

The following requirements must be met for the coupling:

- The contact surface of the sample and the surface of the base plate must be level, flat and ground smooth.
- The impact must be carried out perpendicular to the coupled surface.

Impact devices types	Minimum sample thickness for coupling
D, DC, DL, E	3mm
G	10mm
C	1mm

Coupling procedure:

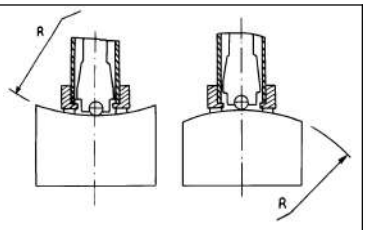
➢ Apply a thin layer of coupling paste to the contact surface of the specimen.	 Application of coupling paste.
➢ Press the specimen firmly against the base plate and spread the paste using circular motions. The coupling process has been carried out properly if there is no longer any metallic contact between the parts.	 Rubbing both parts
➢ Carry out the impact vertically on the specimen. The coupling ensures a rigid connection between the two parts, the absence of surface stress on the specimen and thus reliable test values.	 Coupled specimen

Insufficiently coupled samples produce large variations of individual measurements, HL values which are too high and the operation is characterized by a rattling noise upon impact of the test tip.

5.1.3 Surface curvature of the test piece

Make sure that the radius of curvature of the sample surfaces is not less than 30 mm.
The unit can only work properly when the impact body is in a particular position in the guide tube at the time of impact on the test surface. In the standard position, the tip of the impact body is precisely at the end of the tube.

Impact device types	Radius
Impact device type G	R_{min} =50 mm
Impact device types D/DC, C and E	R_{min} =30 mm

When concave or convex surfaces are tested, the impact body either does not entirely leave the test tube or comes out too far. Special support rings are available to accommodate smaller radii on convex or concave surface.	

5.2 Triggering the impact

Caution: Incorrect triggering of the impact may lead to incorrect measured values. When the impact is incorrectly triggered (e.g. the impact device is not correctly positioned), the measured values can be incorrect.
Arm the unit and trigger the impact in two separate motions. Do not carry out an impact in an area that has already been deformed by another impact.
Measuring procedure:

➢ Depress loading tube carefully until contact is felt. ➢ Allow it to slowly return to the starting position. The device is now ready for carry out the hardness test. *Handling of impact device DC: Place the loading stick adjacent to the test area. Then plunge the face of impact device (coil side) over the stick and press down until it reaches the stop position.*	 Arming
➢ Hold the impact device near the support ring and place it firmly on the test surface.	 Positioning
➢ Trigger the impact by exerting light pressure on the release button (take care to not compress the spring) The impact body is released by the catch chunk and launched onto the test surface with a defined energy. The result is immediately shown in the selected hardness scale on the display. If the indicating device has previously been in standby mode, it will return to run mode again immediately due to the measuring process.	 Testing

➢ Repeat the procedure for a further impact. After closing the measurement series, the statistics are automatically calculated and the result is displayed. If a measurement failed, there is a visual signal

(and depending on the warn sound settings an acoustic one).

Note: The measurement series is automatically completed when the currently set number of measurements per series (average times) is reached. The following measurement is then the first value of the new measurement series.

5.3 Conversion Deviations

Measurements with a set conversion produce a scattering. The conversion deviation is the variance resulting from the comparison of measuring values observed with different hardness testing methods. It includes 2 components. The major share is caused by the fact that there is no clear physical relationship between the various methods. The second component results from the circumstance that the comparison of the hardness values (e.g. HL value and Brinell) also includes the measuring deviation of the method being compared to. Therefore, a conversion between hardness values contains inaccuracies from the outset.

This applies not only to conversion of the HL value into static indentation hardness values, but also for converting from one static hardness measuring method to another. The conversion deviations (±HB, ±HV, etc.) represent “standard deviations”, i.e. 68% of all materials tested to date fell within the specified variance range.

Comparing hardness values with each other is thus always subject to inaccuracies. This not only holds true for the conversion of the HL value to static hardness values but also for the conversion of one static hardness value to another.

If the measurement series is not yet closed, a conversion scale can be selected at any time: before, during or after the measuring process.

Number of impacts per measuring area

- Test each measuring area by at least 3 to 5 impacts.
- Do not impact the same point more than once.

If the range within the same measuring area exceeds R≧30HL, check whether the surface of the sample has been adequately ground or whether the sample yields or flexes during the test impact.

Minimum spaces between impact points

Impact device types	Distance of center of the two indentations	Distance of center of the indentation to sample edge
	mm	mm
D、DC	3	5
DL	3	5
D+15	3	5
G	4	8
E	3	5
C	2	4

6 Fault and Troubleshooting

Fault description	Possible Causes	Troubleshooting
The main unit can't start up	Low battery voltage	Replace the batteries
	Reversal of the battery installation	Pay attention to the battery polarity
	The device is too cold	Go to a room with higher temperatures
Automatically shut off shortly after startup	Low battery voltage	Replace the batteries
No impact	Impact body is not inserted or incorrectly inserted in the impact unit	Insert the impact body correctly
	Impact body is not released or cannot be armed	Use new impact body; Have the impact device checked or replace the impact device.
No testing value	Poor cable contact or cable broken	Replace the cable for the impact device
The impact device can't be identified correctly	Broken of the impact device cable	Replace the cable. Or disable the auto-identifying option.
The impact direction can't be detected correctly	No proper base calibration	Calibrate the instrument using the base calibration function
Erroneous measured values	No proper base calibration	Calibrate the instrument using the base calibration and multi-point calibration functions
	The tip ball of the impact device is badly worn	Replace the tip ball
	The test sample is not properly supported	Support the test sample properly
Measured values on test block are continuously too low	Impact device is dirty; Impact body is damaged	Replace impact body
Measured values on test block are continuously too high	Impact body tip flattened	Replace impact body
	Test block is worn	Replace test block
Poor repeatability of the test value	The tip ball of the impact device is badly worn	Replace the tip ball
	The test sample is not properly supported	Support the test sample properly
	The surface condition of the workpiece is poor	Carefully prepare the testing point and sample for the impact
The keypad can't function properly	Fault of the keypad circuit	Check the connection of the keypad to the main board. Or replace the keypad.
The tester can't communicate via USB	The PC software or the USB driver is not installed correctly	Reinstall the PC software and the USB driver.
	The main unit is not on	Turn on the unit before communicating

7 Maintenance, storage and care

7.1 Performance check (before each use)

The performance check verifies the mechanical and electronic functions of the impact device and the main unit. It is accomplished by measuring the hardness value HL of the test block applicable to the particular type of impact device.

7.1.1 The main unit

- Check the operability of the display.

- Check the capacity of the battery.

7.1.2 Mechanical and electronic checks

The performance check of the unit should be carried out as follows:
- In the case of continuous operation, at least once a day or at least after every 1000 impacts
- In the case of infrequent operation, before the beginning and at the end of a test series

The performance check is done by measuring the hardness value HL on the test block.
- Clean the impact device.
- Carry out impacts on a test block at an interval of 3~5 mm (approx. 3~5 impacts).
- Read the mean HL and compare it with the hardness value as marked on the test block.

The impact device is working properly when the mean value is within the tolerances of ±6 HLD and the range R does not exceed 12 HLD. If it deviates from the mentioned tolerances:
Mean value too high or too low:
- Change the impact body.
- Check the wear and mounting of the support ring and replace it if necessary.
- Clean the impact device

If the impact device still shows excessive deviations, do not use the impact device anymore and send it to the manufacturer to be checked.

7.2 Maintenance

After the impact device has been used for 1000 to 2000 times, please use the nylon brush provided to clean the guide tube and the impact body. Follow these steps when cleaning the guide tube,
- Step1, unscrew the support ring
- Step2, take out the impact body
- Step3, spiral the nylon brush in counterclockwise direction into the bottom of guide tube and take it out for 5 times
- Step4, install the impact body and support ring when complete.

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

Maintenance of the impact body

To ensure that the impact body is good condition, it should be tested regularly on a test block (performance check). The impact body is subject to wear and can be easily and economically replaced by the user (calibration of the impact device is required). The impact body is assembled in a special manner with critical precision and cannot be repaired.

Standard test blocks

Densely impacted standard test blocks cannot be restored by grinding. Through grinding, the original hardness is altered in an uneven and uncontrolled manner. Therefore the standard test blocks can neither be calibrated for a new mean value nor for an acceptable ±tolerance.

7.2 Repair

If the error between the test value and the nominal value is bigger than 2 HRC when testing on the standard Rockwell hardness block, it may be caused by the abrasion of the impact device tip ball. When this happens, it is suggested to replace the tip ball or replace the impact body.
When there is some problem with the hardness tester that the operator can't solve, do not dismantle or adjust any fixedly assembled parts. Fill in the warranty card and send it together with the tester to us for repair.

7.3 Transport and storage conditions

Only store the instrument in the original packaging and in a dry room that is as free from dust as possible. Keep it away from vibration, strong magnetic field, corrosive medium and dumpiness. Store it under ordinary temperature.
With original package, transport is allowed on the third grade highway.

7.4 Cleaning (after each use)

The devices do not require any particular care other than periodic cleaning of the impact body and the guide tube after performing approximately 1000 to 2000 tests.
To clean the guide tube of the impact device,

- Unscrew the support ring.
- Remove the impact body from the guide tube.
- Clean all dirt and metallic powder from the impact body.
- Clean the guide tube with the cleaning brush (accessory).

If necessary, clean the gaps with a pneumatic pump (not compressed air!).
Do not apply oil, grease or other lubricants to any parts for the impact device.
After cleaning, test the calibration of the impact device and recalibrate it if necessary.
To clean the main unit,

- Clean the display with a clean, dry cloth after each use.
- Clean any dirty input socket with a clean, dry brush.

Never immerse the unit in water or clean it under running water.
Do not use abrasives, solvents or lubricants to clean the unit.

7.5 Warranty

When used in accordance with the manufacturer's written instructions and under normal operating conditions, the instrument is conditionally guaranteed to be free from defects in material and workmanship for a period of two years from date of shipment.
This warranty shall not apply to equipment subjected to misuse or abuse, improper installation, alteration, neglect, or accident. Excluded from this warranty are expendable items such as the tip ball of the impact body inside the impact device, interconnecting cables, and batteries.
This warranty is limited to the original purchaser and is not transferable. No other warranty, expressed or implied, is made.

7.6 Tips on safety

The design of the instrument meets safety standard. During the operation, it shall meet the specified external ambient condition, and the operator shall be furnished with concerned technology background, so as to guarantee safe operation.

Note:

1. This hardness tester and its components are not to be used by children or any under the influence of alcohol, drugs or medication.
2. The instrument is limited to be used in lab and industrial environment.

Appendix

Table 1

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 ～ 99.8			47.7 ～ 99.9		37.0 ～ 99.9
	HRA	59.1 ～ 85.8				61.7 ～ 88.0	
	HB	81～654	80～638	80～683	90～646	83～663	81～646
	HV	81～955	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 aluminum alloys	HB	19～164		23～210	32～168		
	HRB	23.8 ～ 84.6		22.7 ～ 85.0	23.8 ～ 85.5		
BRASS(copper-zinc alloys)	HB	40～173					
	HRB	13.5 ～ 95.3					
BRONZE(copper-aluminum/tin alloys)	HB	60～290					
Wrought copper alloys	HB	45～315					

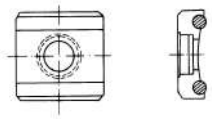
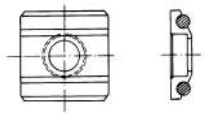
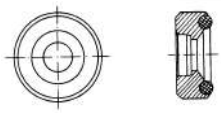
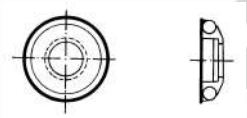
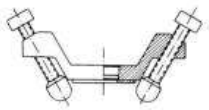
Table 2

No.	Material	Testing Range (HLD)	Strength σ_b(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 3

Impact device		DC(D)/DL	D+15	C	G	E
Impacting energy Mass of impact body		11mJ 5.5g/7.2g	11mJ 7.8g	2.7mJ 3.0g	90mJ 20.0g	11mJ 5.5g
Tip hardness: Dia. tip: Material of 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
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						
Hardness 300HV	Indentation diameter Depth of indentation	0.54mm 24μm	0.54mm 24μm	0.38mm 12μm	1.03mm 53μm	0.54mm 24μm
Hardness 600HV	Indentation diameter Depth of indentation	0.54mm 17μm	0.54mm 17μm	0.32mm 8μm	0.90mm 41μm	0.54mm 17μm
Hardness 800HV	Indentation diameter Depth of indentation	0.35mm 10μm	0.35mm 10μm	0.30mm 7μm	-- --	0.35mm 10μm
Suitability		DC: Test hole or hollow cylindrical; DL:Testslender narrow groove or hole	Test groove or reentrant surface	Test small,light, thin parts and surface of hardened layer	Test large, thick,heavy and rough surface steel	Test super high hardness material

Table 4

No.	Type	Sketch	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 R10～∞

User Notes

Warranty：

The product is guaranteed for one year since purchased. Log www.mitech-ndt.com or follow our company official public platform to register for maintenance. Please fill the blanks as required, if the product is not registered for maintenance, it will follow the date of manufacturer.

When applying for maintenance, please visit our official website, www.mitech-ndt.com or official accounts, submit “online reporting to repair” sheet.

In accordance with the international relevant regulations, the following are not within the scope of free warranty,

- Damage caused by man-made or improper keeping;
- Self-dismantle or non-special repair shop dismantle;
- Do not follow the requirement of service registration or warranty expired;
- Consumable parts.

Service promise：

- MITECH users have lifelong maintenance service
- Free maintenance, inspection, software upgrade and etc.