

Portable Hardness Tester w/Printer

Model No. PHT-3500



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1 Overview

1.1 Advantages

- Wide measuring range. Based on the principle of Leeb hardness testing theory. It can measure the Leeb hardness of all metallic materials.
- Large screen(128×64 dot matrix LCD), showing all functions and parameters.
- Test at any angle, even upside down.
- Direct display of hardness scales HRB, HRC, HRA, HV, HB, HS, HL.
- Seven impact devices are available for special application. Automatically identify the type of impact devices.
- Large capacity memory could store 500 groups (Relative to average times 32~1) 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 exceeds the preset limit.
- Battery symbol indicates the remaining capacity of the battery and the charge status.
- User calibration function.
- Software to connect with PC via USB port.
- With EL background light.
- Integrated thermal printer, convenient for in field printing.
- NI-MH rechargeable battery as the power source. Continuous working period of no less than 150 hours (Backlight and Printer off).
- Auto power off to save energy.
- Overall dimensions: 212mm×80mm×32mm

1.2 Main Application & Testing Range

1.2.1 Main Application

- Die cavity of molds
- Bearings and other large parts
- Failure analysis of pressure vessel, steam generator and other equipment
- Large, hard parts
- The installed machinery and permanently assembled parts
- 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

Testing range refer to Table 1 and Table 2 in the Appendix.

1.3 Configuration

Table 1-1

	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 (I)	1	
	5	Small support ring	1	
	6	Battery Charger	1	9V 500mA
	7	Paper for printing	1	
	8	Manual	1	
	9	Instrument case	1	
Optional Configuration	11	Cleaning brush (II)	1	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.
	13	DataPro software	1	
	14	Communication cable	1	
	15			
	16			

1.4 Working Conditions

- Working temperature: $-10^{\circ}\sim+50^{\circ}\text{C}$;
- Storage temperature: $-30^{\circ}\sim+60^{\circ}\text{C}$;
- Relative humidity: $\leq 90\%$;
- The surrounding environment should be void of vibration, strong magnetic field, corrosive medium, viscous liquids and heavy dust.

1.5 Safety Instructions

- The instrument can only work with the specially designed battery pack and power adapter (charger) supplied with the PHT-3500. Working with others may result in damage of the instrument, battery leakage, and / or fire.
- Do not dispose of the battery pack into fire and do not short circuit, disassemble or heat the battery pack, otherwise battery leakage, fire or even explosion may occur.
- Do not open the cover of the paper compartment or contact any surface of the thermal printer to avoid burns from the heating element.

2 Structure Feature & Testing Principle

2.1 Structure Feature

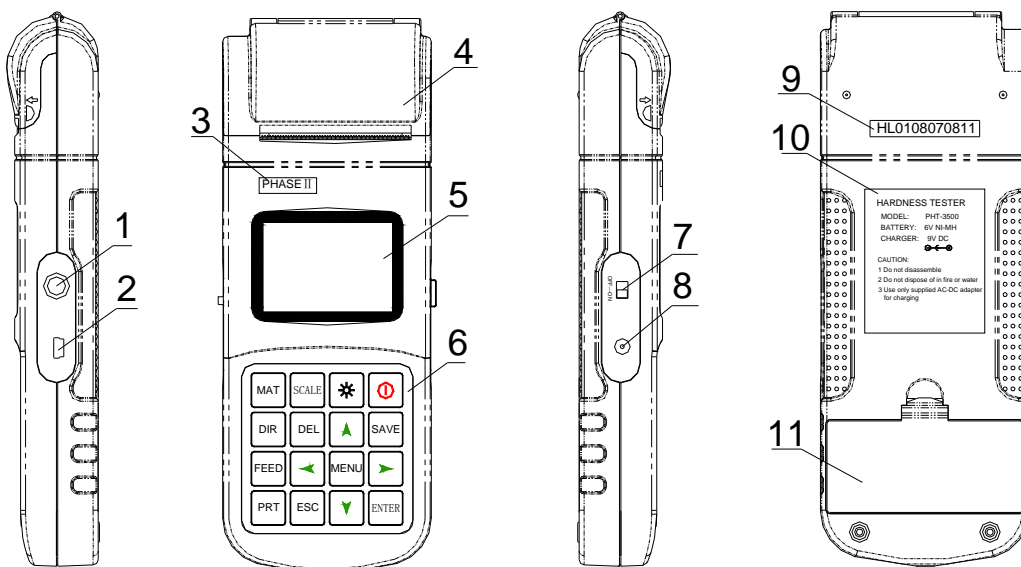
2.1.1 The Hardness Tester Appearance

1. Main unit

2. Impact device

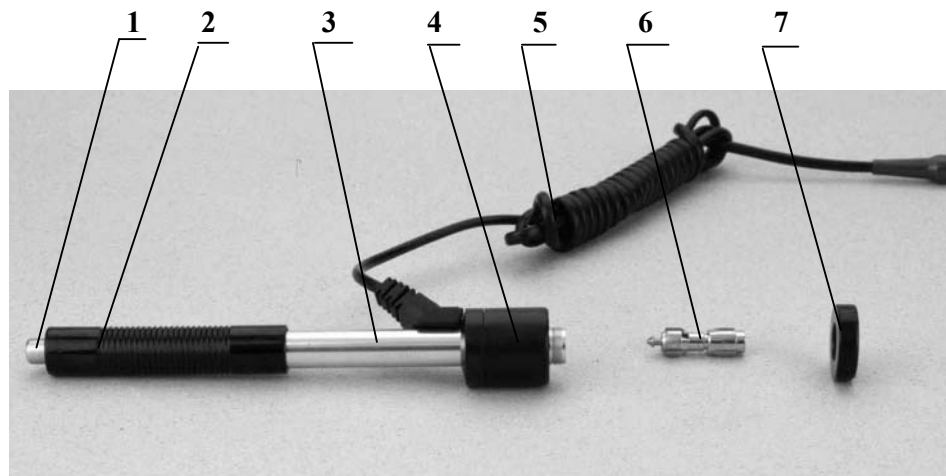


2.1.2 Parts of the Main body



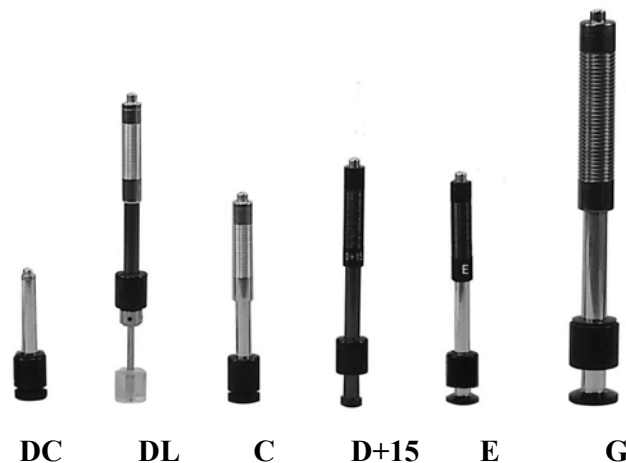
1 Socket of impact device 2 USB port 3 Phase II 4 Paper compartment cover
 5 LCD display 6 Keypad 7 Battery switch 8 Power jack 9 Serial Number
 10 Product label 11 Battery compartment cover

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: use an impact body of certain weight impacts against the testing surface under certain test force, then measure the impacting velocity and the rebounding velocity of the impact body respectively when the spherically test tip is located 1mm above the testing surface.

The calculation formula is as follows:

$$HL=1000 \times VB / VA$$

Where, HL—— Leeb hardness value

VB—— Rebounding velocity of the impact body

VA—— Impacting velocity of the impact body

3 Technical Specifications

- Error and repeatability of displayed value see Table 3-1.

Table 3-1

No.	Type of impact device	Hardness value of Leeb standard hardness block	Error of displayed value	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: HLD (170~960) HLD
- Measuring direction: 360°
- Hardness Scale: HL、HB、HRB、HRC、HRA、HV、HS
- Display: dot matrix LCD, 128×64 dots
- Data memory: 500 groups max. (relative to impact times 32~1)
- Printing paper: width is (57.5±0.5) mm, diameter is 30mm
- Battery pack: 6V NI-MH
- Battery charger: 9V/500mA
- Continuous working period: about 150 hours (With backlight off, no printing)
- Communication interface: USB1.1

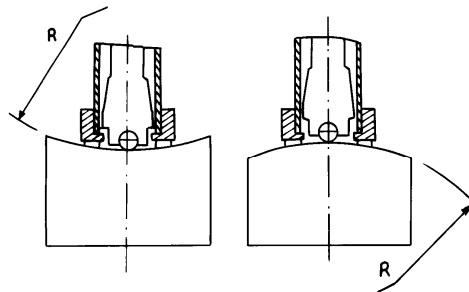
4 Preparation & Testing

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 3.

- 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 luster, smoothing and polish, without oil stain.
- Support of test sample. Support is not necessary for large hard parts. Medium-weight parts might need to be coupled to a large flat surface for stability.
- 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 being tested must be close to 1" thick of solid material and should conform to Table 3.
- For the sample with hardened layer on surface, the depth of hardened layer should conform to Table 3.
- Coupling. Light-weight sample must be firmly coupled with a heavy base plate. Both coupled surface must be flat and smooth. The impact direction must be vertical to the coupled surface. When the sample is a large plate or long rod it can be deformed and become unstable, even though its weight and thickness meets minimum standards, and accordingly, the test value may not be accurate. So the sample should be reinforced or supported at its back.
- Magnetism of the sample itself should be avoided.

4.1.2 System Setting

See 6.9 for details.

4.1.3 Presetting Testing condition

See 6.5 for details.

4.2 Testing Program

Verification of the PHT-3500 is performed by testing on the supplied standard test block. The error and repeatability of displayed value should be within the noted tolerance shown in Appendix table 2.

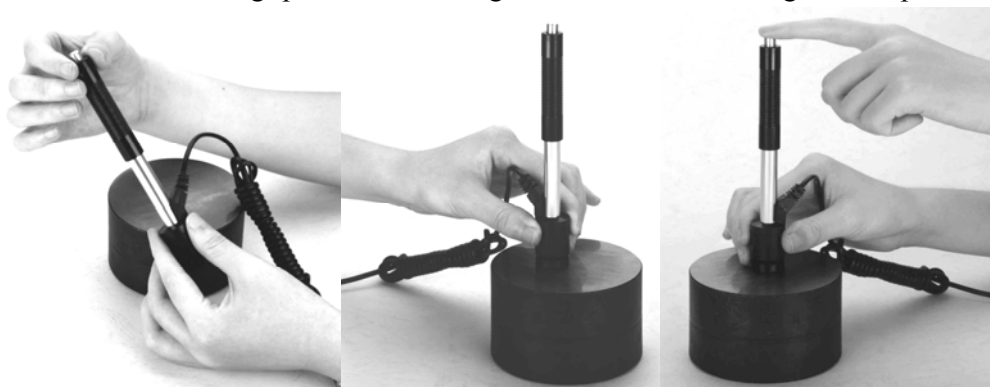
Note : Perform 5 consecutive tests on the supplied test block and retrieve the arithmetic average. This result should be within acceptable tolerance for the respective hardness scale. If this value exceeds the allowable tolerance, you should perform a software calibration to bring the unit back into acceptable tolerance. Instructions are shown in section 6.11.

4.2.1 Start-Up

- Insert the plug of the impact device into the socket of impact device on the tester.
- Press **【①】** key, to power the unit on. The instrument is in testing condition.

4.2.2 Loading

Pushing the loading-tube downwards until contact is felt. Then allow it to slowly return to the starting position or using other method locking the impact body.



4.2.3 Localization

Stand 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

- Gently 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 area should be tested a minimum of 5 times. The result data dispersion should not more than mean value \pm 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 4-1.

Table 4-1

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

4.2.5 Read measured value

4.2.6 Power Off

Press **【①】** key to turn off the instrument.

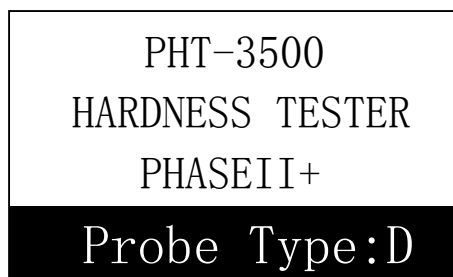
5: Notes

- Replacing the impact device must be done while the unit is powered off. Otherwise the main body cannot identify the type of the impact device, and it can damage the circuit board of the main body.
- You could not save the current test value if the test times are less than the presetting times value.
(ie: average set at 5 times. You must take minimum of 5 tests to save the values)
- Only type D and type DC of impact device have the function of strength measure option. You cannot modify the **【Set hardness orσb】** setting when using other types of impact device. The **【Set hardness orσb】** 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 scales. The hardness scale is reset to HL automatically after changing the material. So select material first before changing the hardness scale.

6 Operation in Details

6.1 Power On

Press **【①】** to power on the system. The screen shows as below:



The system will 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.

Note: *If the instrument is powered off, it will turn on automatically after the charger is connected.*

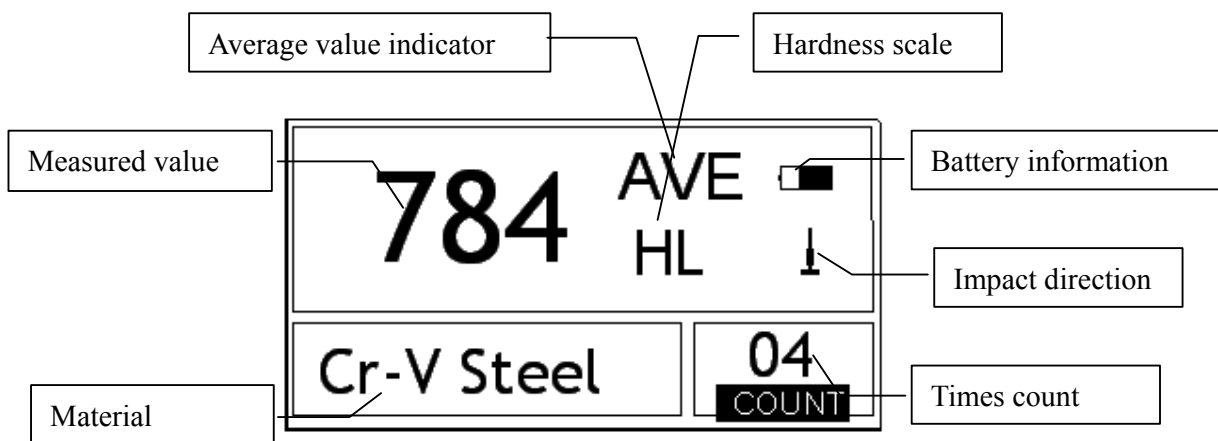
6.2 Power Off

Press key **【①】** will power off the system.

Note: *If the charge power is connected, the instrument will turn on automatically after pressing the power off key.*

6.3 Testing

Below is the main display interface:



6.3.1 Instruction of the Main Display Interface

Battery symbol: Display the information of the remaining capacity of the battery, and the charging status.

Impact direction: The present impact direction.

Average value indicator: It appears to show the mean value of the samples when reaching the preset test times.

Hardness scale: Hardness scale 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 over conversion or measure range. ↓ means lower than conversion or measure range.

Material: The present preset material.

Impact times count: Amount of tests taken.

6.3.2 Testing Operation at the Main Display Interface

Testing operation could be carried out under this interface. After each impact operation, it can display the current measured value, impact times count plus one, the buzzer would alert you if the measured value is not within the tolerance limit. The beeper will sound when reaching the preset impact times. After 2 seconds, the beeper will sound again and display the mean value.

6.3.3 Key Operation at the Main Display Interface

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



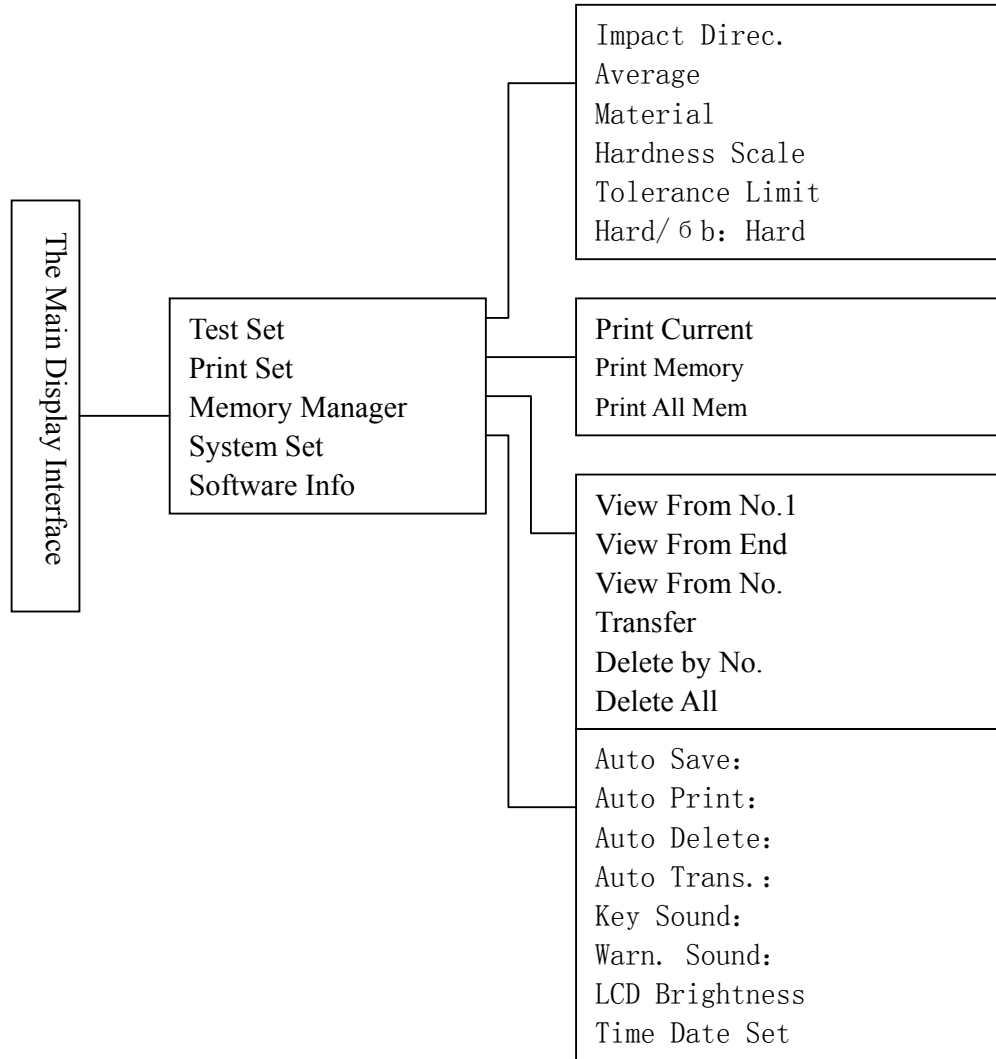
Press key **【◀】** or key **【▶】** to move the cursor to **【YES】** or **【NO】**. Press key **【ENTER】** to confirm operation. Press key **【ESC】** to cancel delete operation.

- Press key **【▲】** or **【▼】** could display single measured value.
- Press key **【*】** could switch on of off the background light of LCD.
- Press key **【MENU】** could enter the system presetting menu.
- Press key **【DIR】** to set the impact direction.
- Press key **【CNT】** to change the impact times in one group. The impact times count item will be highlighted when first pressing the key **【CNT】**, and the impact times count value will increase by one each time you press this button. The value will roll back to 1 when it reaches 32.
- Press key **【SCALE】** to change the hardness scale.

- Press key **【MAT】** to change the material set. Presetting hardness scale defaults to HL automatically after material presetting changed.

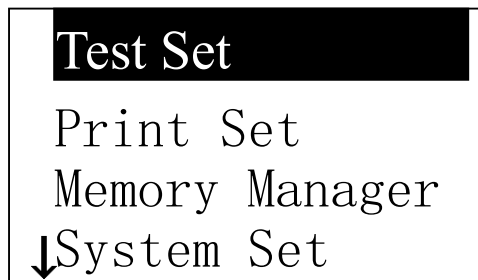
6.4 Menu Structure

Both presetting system parameters and other additional function could be obtained within the menu operation. At the main display interface, press key **【MENU】** into the main menu.



6.5 Test Set

At the main display interface, press key **【MENU】** to enter the main menu.



Press key **【ENTER】** to enter Test Set Menu.

The symbol ↓ at the left side of underside menu indicates that the menu has not ended. Press key **【▼】** could continuously glance downward. The symbol ↑ at the left side of the upside menu indicates that the menu has not ended. Press **【▲】** could continuously glance upward.

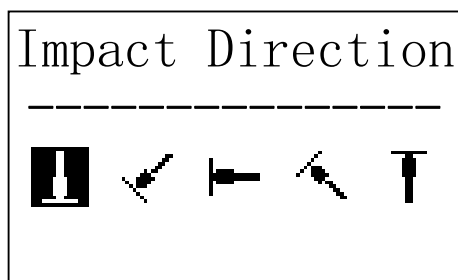
Press key **【▲】** or **【▼】** to move the cursor to the line you want to set, and press key **【ENTER】** to confirm it.

Note: 1. When **【Hard/δb】 is switched to δb, the hardness scale could not be selected. The cursor will skip over **【Hardness Scale】** while moves the cursor.**

2. Only D type of impact device has the function of δb measure. So the cursor could not move to **【Hard/δb】 while use other impact device.**

Impact Direc.
Average
Material
Hardness Scale
Tolerance Limit
Hard/ δ b:Hard

6.5.1 Impact Direction Setting

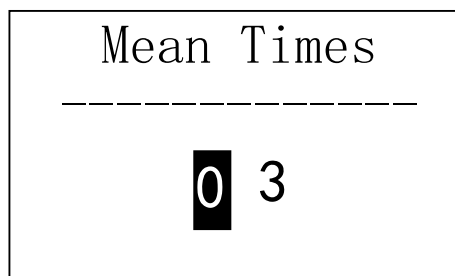


Press key **【◀】** or **【▶】** to move the cursor to the impact direction that you will preset.

Press key **【ENTER】** to confirm it.

Press key **【ESC】** to cancel it.

6.5.2 Average Times Setting

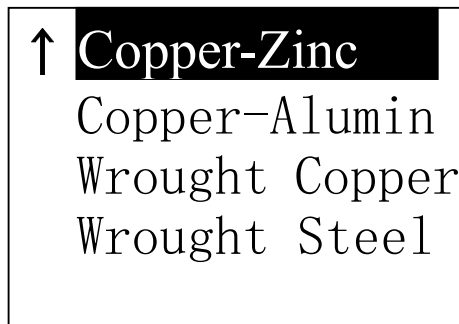


Press **【▲】****【▼】** to move the cursor.

Press **【▶】****【◀】** to change the number. Press key **【ENTER】** to confirm it. Press key **【ESC】** to cancel it.

6.5.3 Material Setting

When **【Hard/6b】** is preset to hardness, it will display the following material: 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.



Press key **【▲】** or **【▼】** to move the cursor to the material you want to preset.

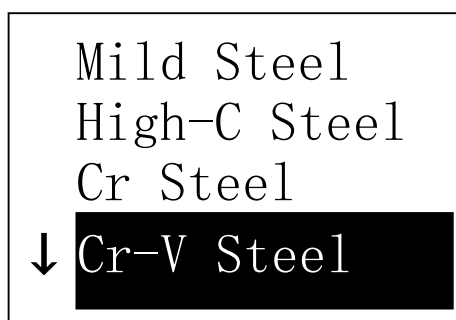
Press key **【ENTER】** to confirm it.

Press key **【ESC】** to cancel it.

Note 1. Presetting hardness scale defaults to HL automatically after material presetting is changed.

2. Please select material first, then select hardness scale.

When **【Hard/ 6b】** is preset to 6b, it will display the following material: 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.

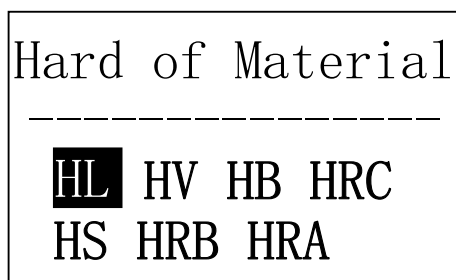


Press key **【▲】** or **【▼】** to move the cursor to the material to want to preset.

Press key **【ENTER】** to confirm it.

Press key **【ESC】** to cancel it.

6.5.4 Hardness Scale Setting



Press key **【<】** 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. This only displays the valid hardness scale for the present selected impact device and material. It will not display the hardness scale which is not valid.

2. Please select material first, then select hardness scale.

3. Presetting hardness scale defaults to HL automatically after presetting

6.5.5 Tolerance Limit Setting

Tolerance Limit	

Min	Max
0 200	0890

material is changed.

Press **【▲】****【▼】** to move the cursor.

Press **【▶】****【◀】** to change the number. 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/δb Setting

↑Material
Hardness Scale
Tolerance Limit
Hard/δb: Hard

Press key **【ENTER】** to switch between Hard and δb .

Note: Only D and DC type of impact device has the function of δb measure. So hard is the only selection if the impact device is not D or DC type.

6.6 Print Function

At the main display interface, press **【MENU】** to enter the main menu. Press **【▲】****【▼】** to move the cursor to print menu and press **【ENTER】** to enter the print menu.

Note:

- **Printing function is unavailable while charging.**
- **Printing can be stopped by pressing the **【ESC】** key.**
- **Do not open the cover of the paper compartment during printing. Otherwise the instrument may not print normally.**
- **Over high ambient humidity (above 85% of relative humidity) or over low ambient humidity (below 20% of relative humidity) may reduce the print quality.**
- **Printing with paper that has been stored for over long period of time or of poor quality may reduce the print quality or even damage the printer.**

6.6.1 Print Current

Printing out the data report of last test performed. If the instrument hasn't been switched off, and hasn't changed any testing condition during continuous printing process, it will only print out single measured value and average value when printing again.

6.6.2 Print Memory

Print out the selected group of measured value stored inside the instrument.

6.6.3 Print All Memory

Print out all the measured value stored inside the instrument.

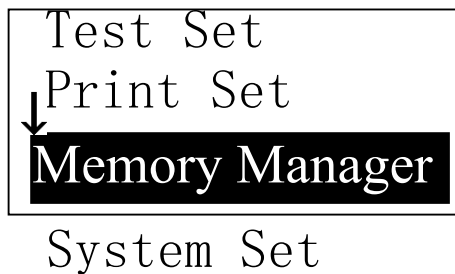
6.6.4 Paper Feeding

When the printer is powered on and ready for printing, press **【FEED】** key then the instrument will start manual paper feeding. Press and keep holding the **【FEED】** key to start paper feeding, while releasing the key to stop paper feeding.

Note: Manual paper feeding is unavailable while charging.

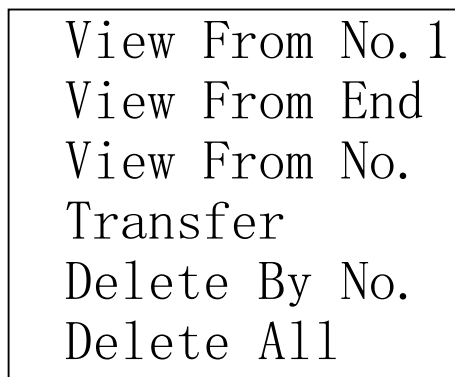
6.7. Memory Manager

At the main display interface, press key **【MENU】** enter the main menu.



Press key **【▲】** or key **【▼】** to move the cursor to **【Memory Manager】**. Press key **【ENTER】** into **【Memory Manager】** menu.

If there is no data in the memory, displays: <No Data!>. Then return.



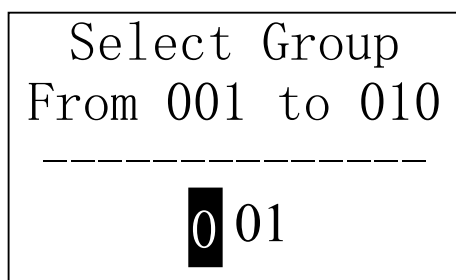
Press key **【▲】** or key **【▼】** to move the cursor to the function wanted, then press key **【ENTER】** to confirm.

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.

6.7.2 View from Selected No. Group



Select Group
From 001 to 010

0 01

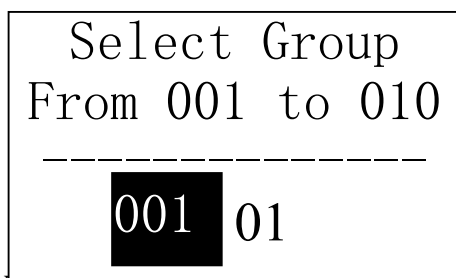
Press **▲** **▼** to move the cursor.

Press **▶** **◀** to change the number. Press key **ENTER** to start displaying memory data from the selected beginning group. Press key **ESC** to cancel current operation.

6.7.3 Data Transfer

Transfer export the values stored in the memory as text format to PC through USB port. This function is not available now.

6.7.4 Delete by Group No.



Select Group
From 001 to 010

001 01

Delete by No. displays selecting the range of deleting groups.

Press **▲** **▼** to move the cursor.

Press **▶** **◀** to change the number. Press key **ENTER** to delete the selected groups. Press key **ESC** to cancel operation.

Note: 1. If the preset group number exceeds the actual range, then deletes the actual groups among them.

2. Do not shut down the instrument while deleting data. It could lead to unpredicted consequence if shutting down while deleting.

6.7.5 Delete All Data

Delete All will delete all the data in the memory.

6.7.6 Deletion Confirmation



Confirm delete?

YES NO

Press key **◀** or **▶** to move the cursor to **YES** and press key **ENTER** to confirm deleting operation.

Press key **◀** or **▶** to move the cursor to **NO** and press key **ENTER** to cancel deleting



operation.

Press key **【ESC】** could cancel deleting operation, no matter where the cursor is.

6.8 Browsing Memory Data Groups

No. 001	12/03	652HL
No. 002	12/03	587HL
No. 003	12/03	820HL
No. 004	12/03	693HL
No. 005	12/03	783HL
No. 006	12/03	782HL
No. 007	12/03	579HL
No. 008	12/03	687HL

No. 001	12/03	514HL
No. 002	12/03	785HL
No. 003	12/03	516HL
No. 004	12/03	789HL
No. 005	12/03	570HL
No. 006	12/03	852HL
No. 007	12/03	523HL
No. 008	12/03	796HL

No. 001	12/03/02
Average=	514HL
D 	05 times
Steel	

Press key **【▲】** or **【▼】** to see previous or next page.

Press key **【ESC】** to exit browsing.

Press key **【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.

511	513	516	↑
514	515		

Press key **【▲】** or **【▼】** to browse details including average value, test set and each single value.

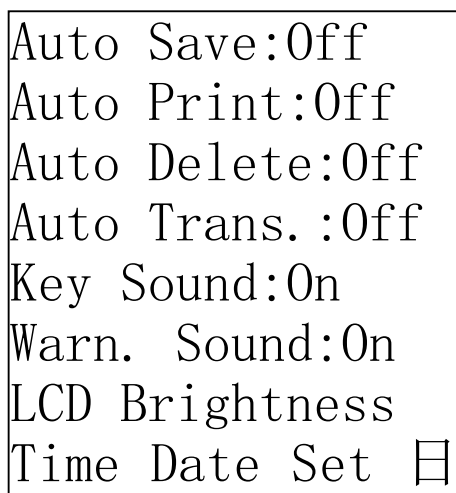
Press **【ESC】** to return to previous display.

6.9 System Set

At the main display interface, press key **【MENU】** enter the main menu.



Press key **【▲】** or key **【▼】** to move the cursor to **【System Set】** Menu.
Press key **【ENTER】** to enter **【System Set】** menu.



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

【Auto Save】 **【Auto Delete】** **【Auto Trans】** **【Key Sound】** **【Warn. Sound】** could be switched on or off.

When **【Auto Save】** is set to <On>, could store the data of current group automatically after measuring and displaying average value.

When **【Auto Print】** is set to <On>, could print the data of current group automatically after measuring and displaying average value.

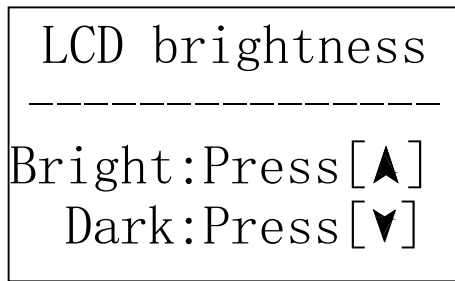
When **【Auto Delete】** is set to <On>, according to 3σ rule, could cancel gross error automatically after having measured presetting average times or pressing end in advance. If there is data canceled, it needs additional test to reach preset times.

When **【Auto Trans.】** is set to <On>, could export the value of present group through communication port after measuring and displaying average value. It's not available now.

When **【Key Sound】** is set to <On>, the buzzer would make a short beep while pressing key each time.

When **【Warn. Sound】** is set to <On>, if the measured value exceeds the tolerance limit, reached the presetting average times or deleting data, the unit will alert you with a beep.

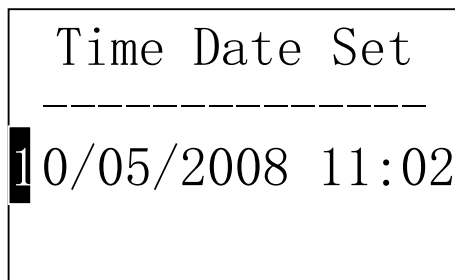
6.9.1 LCD Brightness Set



Press key 【▲】 to enhance the brightness. Press key 【▼】 to weaken the brightness.

Press key 【ENTER】 to confirm the modifying. Press key 【ESC】 to cancel the modifying.

6.9.2 Time Date Set



Present time and date is displayed as“M/D/Y H/M”. Press the figure

【▲】【▼】 keys to modify the present figure. Move the cursor by pressing the 【◀】【▶】keys. Press key 【ENTER】 to confirm modifying. Press key 【ESC】 to cancel modifying and exit.

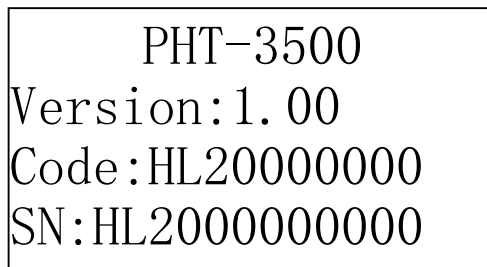
6.10 Software Information

At the main display interface, press key 【MENU】 enter the main menu.



Press key【▲】or key【▼】to move the cursor to 【Software Info】 .

Press key 【ENTER】 into 【Software Info】 screen.

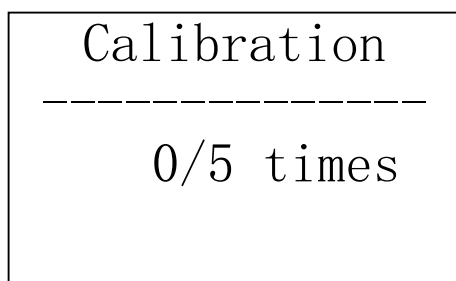


This screen displays the information about the main body and the firmware. The version, the Code and the SN would change with the firmware.

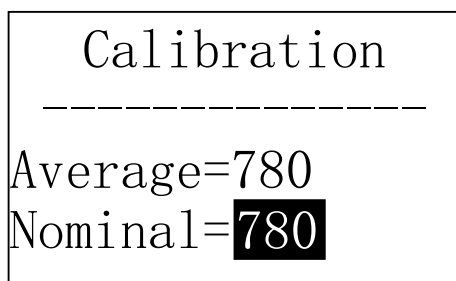
6.11 System Calibration

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

Press key **【①】** , meanwhile 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 key **【▲】** or key **【▼】** to input the nominal value.

Press key **【ENTER】** to confirm.

Press key **【ESC】** to cancel this operation.

Range of adjustment: $\pm 15\text{HL}$.

6.12 EL Background Light

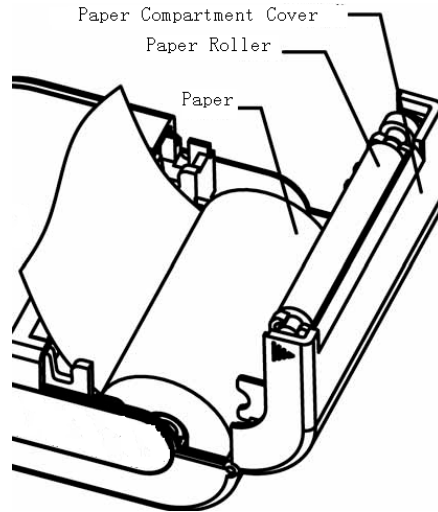
With the background light, it is convenient to work in the dark condition. Press key **【☼】** to switch on or switch off the background light at any moment as you like after power on.

6.13 Auto Power Off


- The instrument has the function of powering off automatically to save power.
- The system would power down automatically if there's neither measuring nor any key operation within 5 minutes. Except key **【①】** , press any key could stop the blinking of LCD screen and stop the operation of power off at the moment.
- While the voltage of the battery is too low, the screen will show **< Battery Empty!>**, then power off automatically.
- When the instrument is being charged, the Auto Power Off will not function.




6.14 Paper Loading

- Hold Both ends of the paper compartment and lift up.
- According to the illustration, put the paper into the paper compartment with attention to the paper direction. If the paper is misplaced, the instrument will fail to print.
- Allow about 1" of paper to stick out of printer head.
- Confirm the roll is in proper position and close the paper compartment cover.



6.15 Battery Charge

The instrument uses a NI-MH battery pack as its power source. When the battery pack runs low, the battery symbol on the display will blink . It should be charged as soon as possible. Try to drain your battery pack as fully as possible before it is charged for longest battery service.

- The battery switch should be at 'ON' condition before charging.
- Plug the power adapter into the mains supply power socket and then plug the charger connector into the power jack of the instrument. If the instrument is in power off condition, it will turn on automatically after the charger plug is inserted into the power jack. The battery symbol will alternately shows between  and  when charging. The darker area of the symbol indicates the amount of charge in the battery. Full darkness means the battery is fully charged.
- When the battery is fully charged, the battery symbol on the display will blink .
- Please use the configured AC-DC adapter to charge the battery pack.

Warning: When the battery pack is being charged, printing or paper feeding is not usable.

6.16 Battery Replacement

When the battery pack fails to hold a charge, the user should replace the batteries following the program below:

- Power down the instrument.
- Take off the battery compartment cover, disconnect the connection from the battery to the circuit board.
- Insert the connection plug of the new battery pack into the socket on the circuit board.
- Reset the battery cover.
- Turn on the instrument to check parameters.

6.17 Connection of Data Transmission Cable

Insert one connection plug of the transmission cable into the USB socket on the right side of main body, and insert the other end into the USB port in your computer.

7 Fault Analysis & Evacuation

Fault Appearance	Fault Analysis	Handling method
Charge failure	Battery failure	Replace the battery with a new pack
	The battery is switched off	Switch on the battery
No measured value	Impact device cable failure	Replace the cable
No Power	Battery drained	Charge the battery
	The battery is switched off	Switch on the battery

8 Servicing & Maintenance

8.1 Impact Device Servicing

After the impact device has been used for 1000--2000 times, please use the nylon brush provided to clean the guide tube and impact body. When cleaning the guide tube, unscrew the support ring first, then take out the impact body, spiral the nylon brush in counter-clock direction into the bottom of guide tube and take it out for 5 times, and then install the impact body and support ring again.

- Release the impact body after use.
- **Any lubricant or cleaning fluid is absolutely prohibited inside the impact device.**

8.2 Normal Maintenance Program

When using standard leeb test block and the error is more than 2 HRC, it may be the impact ball is worn. Changing the spherical test tip or impact body should be considered.

Please do not dismantle or adjust any fixed or assembled parts.

An opened unit will automatically void the stated warranty.

9 Calibration

Calibration should be performed yearly or more often depending upon usage and quality inspections

10 Storage Conditions

- Always avoid vibration, strong magnetic fields, corrosive medium, viscous fluids, metal chips and dust. Store in room temperature.
- Keep PHT-3500 in carry case when not in use.

APPENDIX

Table 1

Material	Method	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 aluminum alloys	HB	19~164		23~210	32~168		
	HRB	23.8~ 84.6		22.7~ 85.0	23.8~85.5		
BRASS(copper-zin c alloys)	HB	40~173					
	HRB	13.5~ 95.3					
BRONZE(copper-a luminum/tin alloys)	HB	60~290					
Wrought copper alloys	HB	45~315					

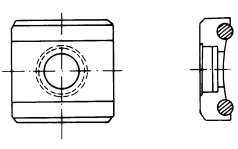
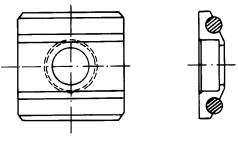
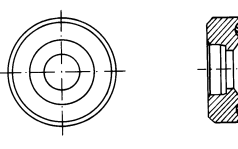
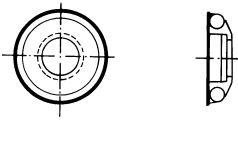
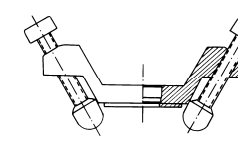
Table 2

No.	Material	HLD	Tensile 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

Type of impact device		DC(D)/DL	D+15	C	G	E
Impacting energy		11mJ	11mJ	2.7mJ	90mJ	11mJ
Mass of impact body		5.5g/7.2g	7.8g	3.0g	20.0g	5.5g
Test tip hardness:		1600HV	1600HV	1600HV	1600HV	5000HV
Dia. Test tip:		3mm	3mm	3mm	5mm	3mm
Material of test tip:		Tungsten carbide	Tungsten carbide	Tungsten carbide	Tungsten carbide	synthetic diamond
Impact device diameter:		20mm	20mm	20mm	30mm	20mm
Impact device length:		86(147)/	162mm	141mm	254mm	155mm
Impact device weight:		75mm 50g	80g	75g	250g	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		>5kg	>5kg	>1.5kg	>15kg	>5kg
Need support firmly		2~5kg	2~5kg	0.5~1.5kg	5~15kg	2~5kg
Need coupling tightly		0.05~2kg	0.05~2kg	0.02~0.5kg	0.5~5kg	0.05~2kg
Min. thickness of sample						
Coupling tightly		5mm	5mm	1mm	10mm	5mm
Min. layer thickness for surface hardening		≥0.8mm	≥0.8mm	≥0.2mm	≥1.2mm	≥0.8mm
Size of tip indentation						
Hardness 300HV	Indentation diameter	0.54mm	0.54mm	0.38mm	1.03mm	0.54mm
	Depth of indentation	24μm	24μm	12μm	53μm	24μm
Hardness 600HV	Indentation diameter	0.54mm	0.54mm	0.32mm	0.90mm	0.54mm
	Depth of indentation	17μm	17μm	8μm	41μm	17μm
Hardness 800HV	Indentation diameter	0.35mm	0.35mm	0.35mm	--	0.35mm
	Depth of indentation	10μm	10μm	7μm	--	10μm
Available type of impact device		DC: Test hole or hollow cylindrical; DL: Tests slender narrow groove or hole	D+15: Test groove or reentrant 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 4

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~ ∞

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