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# **MH210 Leeb Hardness Tester**

## **User's Manual**

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# 1 Overview

## 1.1 MH210 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.
- With EL background light
- Direct display of hardness scales HRB, HRC, 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 $32\sim 1$ ) information including single measured value, mean value, testing date, impact direction, impact times, material and hardness scale etc.
- Upper and lower limit can be preset. It will alarm automatically when the result value exceeding the limit.
- Battery information indicates the rest capacity of the battery.
- Software calibration function.
- Software to connect with PC via RS232 port. Micro printer support.
- Compact metal case, suitable for use under poor working conditions
- Continuous working period of no less than 50 hours with two alkaline batteries(AA size); Auto power off to save energy.
- Outline dimensions: 132 X 76.2 mm
- Weight: 345g

## 1.2 Main Application & Testing Range

### 1.2.1 Main Application

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

### 1.2.2 Testing Range

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 body	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	Alkaline battery	2	AA size
	7	Manual	1	
	8	Instrument case	1	
	9			
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	Micro Printer	1	
	16	Print cable	1	

### 1.4 Working Conditions

Working temperature: 0°C ~ +40°C ;

Storage temperature: -30°C ~ +60°C

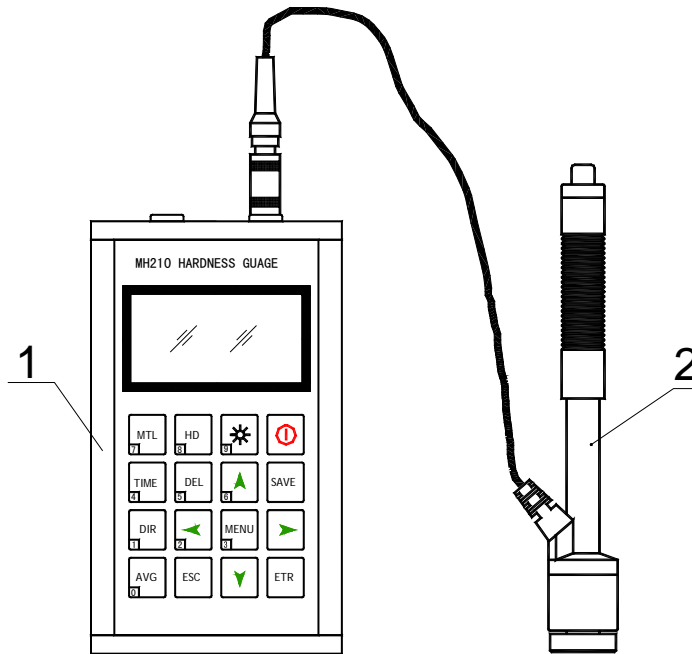
Relative humidity: ≤90% ;

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

## 2 Structure Feature & Testing Principle

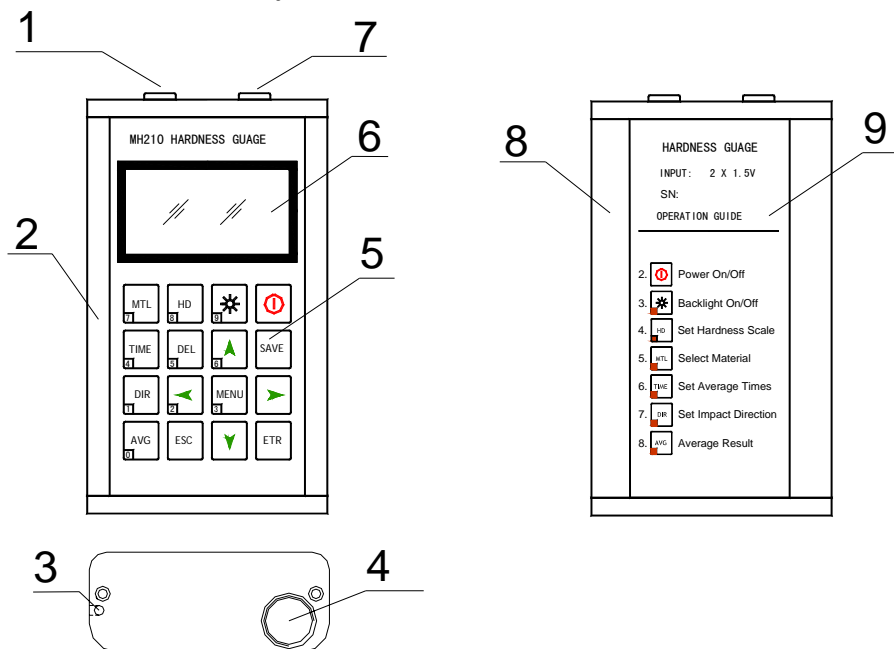
### 2.1 Structure Feature

#### 2.1.1 The Hardness Tester Appearance



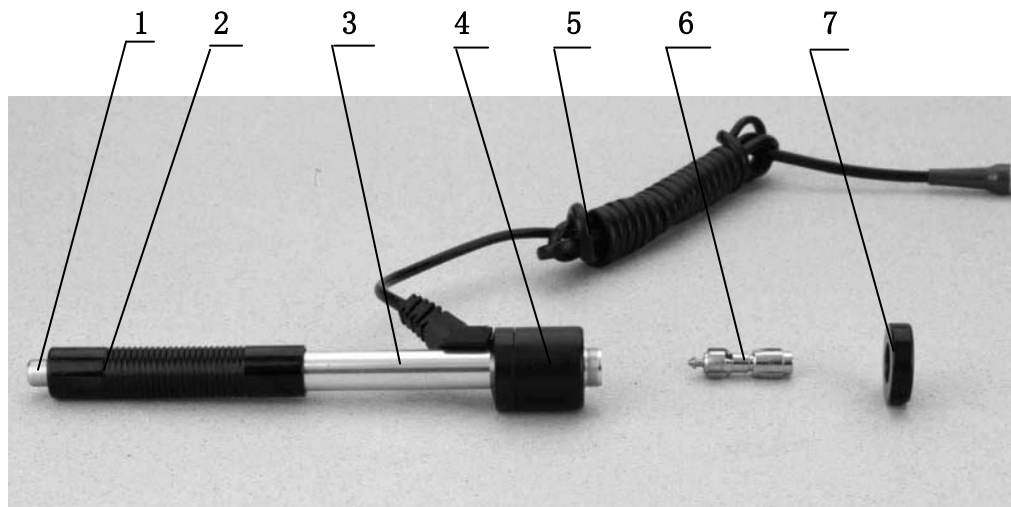
1. Main body 2. Impact device

#### 2.1.2 Parts of the Main body



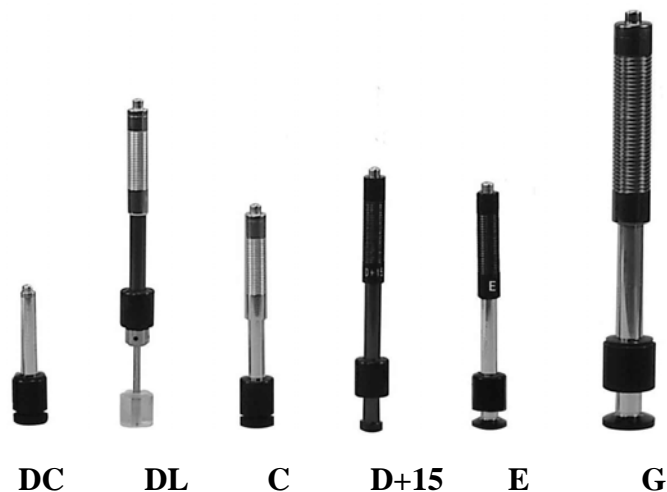
1 Socket of RS232 2 Aluminum case 3 Belt hole 4 Battery cover  
 5 Keypad 6 LCD display 7 Socket of impact device  
 8 Aluminum case 9 Label

### 2.1.3 D Type Impact Device



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

### 2.1.4 Different Types of Impact Device



### 2.2 Leeb Hardness Testing Principle

The basic principle is: to use an impact body of certain weight 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: max. 500 groups (relative to impact times 32~1)
- Working voltage: 3V (2 AA size alkaline battery)
- Continuous working period: about 100 hours (With backlight off)
- Communication interface: RS232



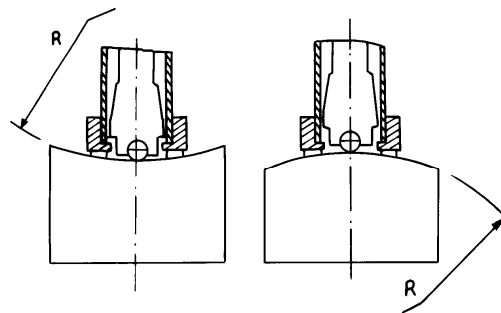
## 4 Preparation & Testing

### 4.1 Preparation & Inspection before Testing

#### 4.1.1 Preparation of Sample Surface

Preparation for sample surface should conform to the relative requirement in the Appendix Table 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 no necessary for heavy sample. Medium-weight parts must be set on the smoothing and stable plane. The sample must set absolutely equability and without any wobble.
- Curved surface: The best testing surface of sample is flat. When the curvature radius  $R$  of the surface to be tested is smaller than 30mm (D, DC, D+15,C, E and DL type of impact device) and smaller than 50mm (G type of impact device), the small support ring or the shaped support rings should be chosen.



- The sample should have enough thickness, minimum thickness of sample should conform to Table 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, and there is no redundant coupling agent existing. The impact direction must be vertical to the coupled surface. When the sample is a big plate, long rod or bending piece, it can be deformed and become unstable, even though its weight and thickness is big enough, 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 tester is by using standard test block. The error and repeatability of displayed value should be within the regulation of Appendix table 2.

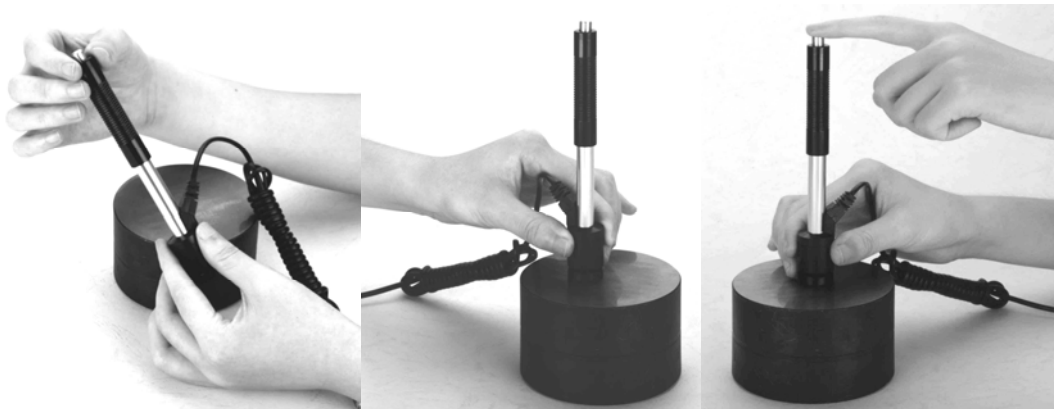
**Note:** Use a calibrated hardness tester, test the standard test block downward vertically for 5 times, the arithmetical average value compare with the value of standard test block. If this value exceeds the standard value, could use the function of software calibration to adjusting.

### 4.2.1 Start-Up

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

### 4.2.2 Loading

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

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

### 4.2.4 Testing

- Press the release button on the upside of the impact device to test. The sample and the impact device as well as the operator are all required to be stable now. The action direction should pass the axis of the impact device.
- Each measure area of the sample usually need 5 times of testing operation. 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.
- If want accurate conversion from the Leeb hardness value to other hardness value, contrastive test is needed to get conversion relations for the special material. Use

inspection qualified Leeb hardness tester and corresponding hardness tester to test at the same sample respectively. For each hardness value, each measure homogeneously 5 points of Leeb hardness value in the surrounding of more than three indentations which need conversion hardness, using Leeb hardness arithmetic average value and corresponding hardness average value as correlative value respectively, make individual hardness contrastive curve. Contrastive curve at least should include three group of correlative data.

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 **【】** key to switch off.

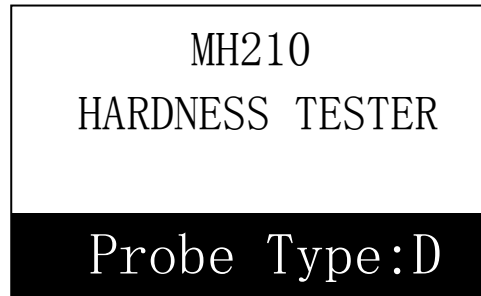
## 5 Advice

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

## 6 Operation in Details


### 6.1 Power On

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



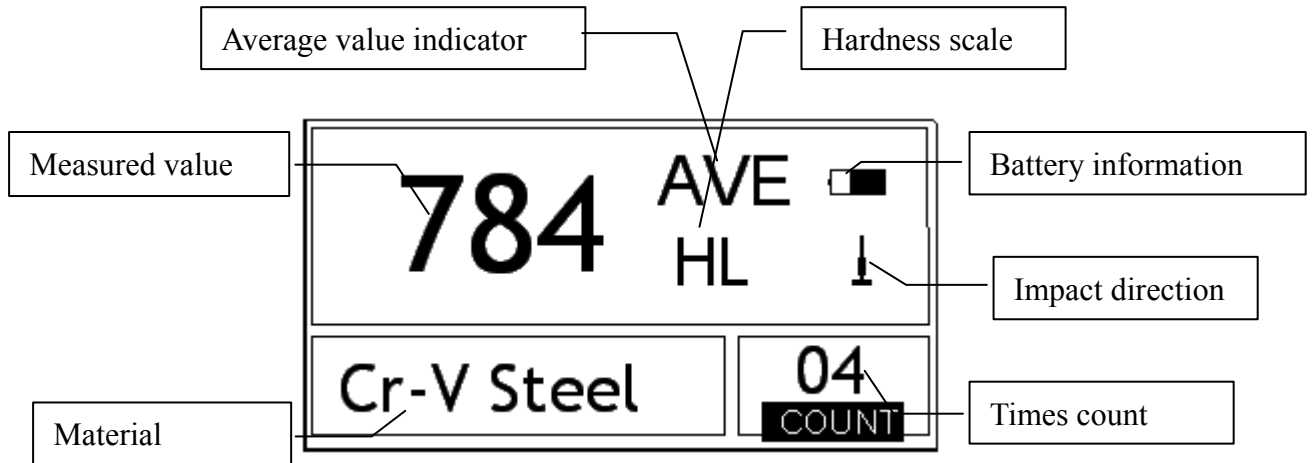
The system would automatically detect the type of the impact device during power up, and would display this information on the screen. Users should pay attention to the probe type displayed on the screen. After pausing for several second, the screen will exit and enter the main display interface.

### 6.2 Power Off

Press key 【】 could power off the system in any conditions.

### 6.3 Testing

Below is the main display interface:



#### 6.3.1 Instruction of the Main Display Interface

**Battery information:** Display the information of the rest capacity of the battery.

**Impact direction:** The present impact direction.

**Average value indicator:** It appears to show the mean value of the samples when reaching the presetting impact times.

*Hardness scale:* Hardness method of the present measured value.

*Measured value:* Display present single time measured value (without mean value indicator), or display the present mean value (with average value indicator prompting). ↑ means over conversion or measure range. ↓ means lower than conversion or measure range.

*Material:* The present presetting material.

*Impact times count:* Times that have been impacted.

### 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 a long howl if the measured value is not within the tolerance limit. When reaching the presetting impact times, the buzzer will alert a long howl. After 2 seconds, the buzzer will alert a short howl, 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:

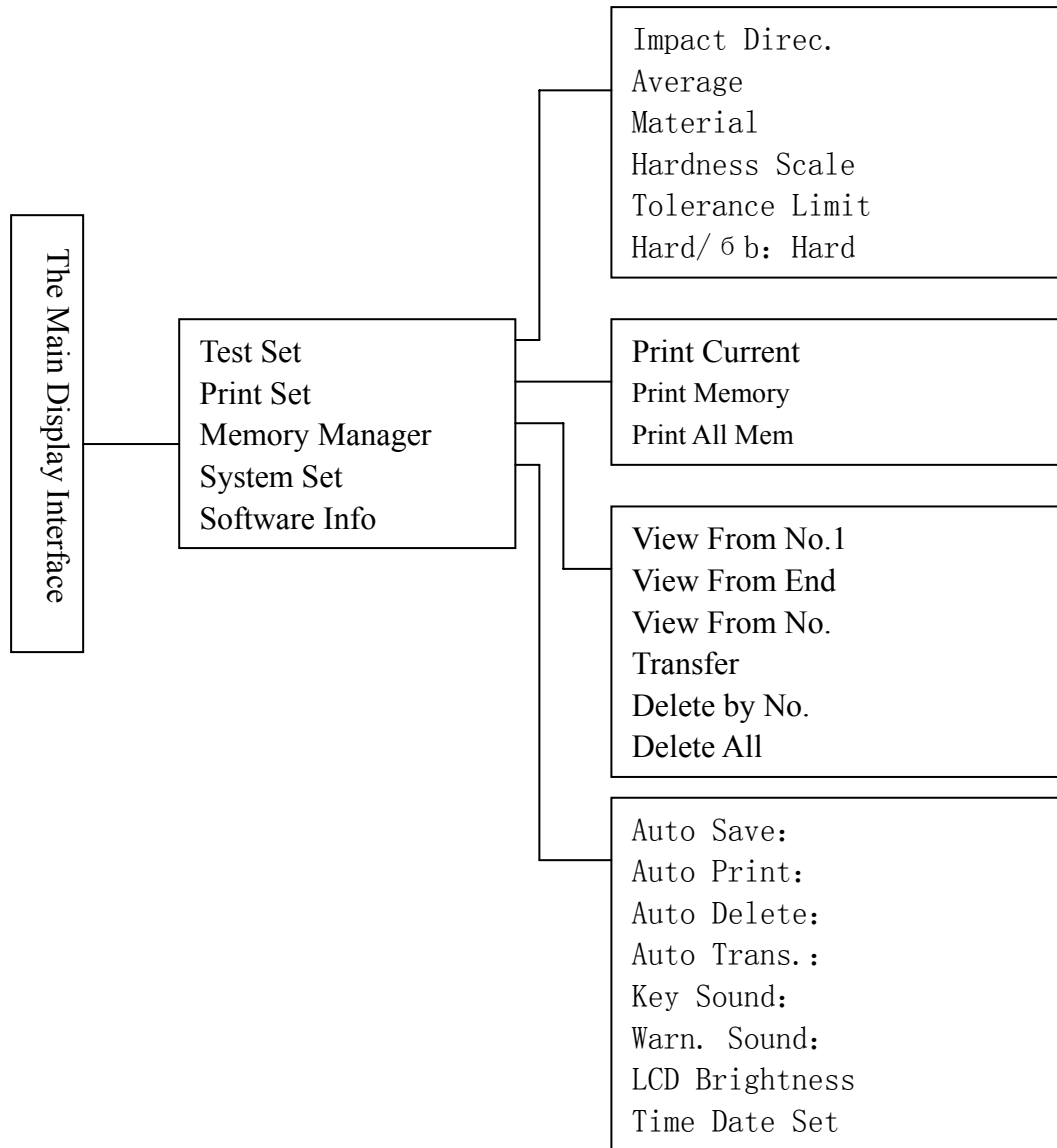


Press key **【◀】** or key **【▶】** to move the cursor to **【YES】** or **【NO】**. Press key **【ETR】** to confirm operation. Press key **【ESC】** to cancel delete operation.

- Press key **【▲】** or **【▼】** could display single measured value.
- Press key **【AVG】** could end off testing while not reaching the presetting impact times, and display the average 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 **【TIME】** to change the impact times in one group. The impact times count item will be highlighted when first pressing the key **【TIME】**, and the impact times count value will plus one with each pressing. The value will roll back to 1 when it reaches 32.
- Press key **【HD】** to change the hardness scale.
- Press key **【MTL】** to change the material set. Presetting hardness scale recovers to HL automatically after material presetting changed.

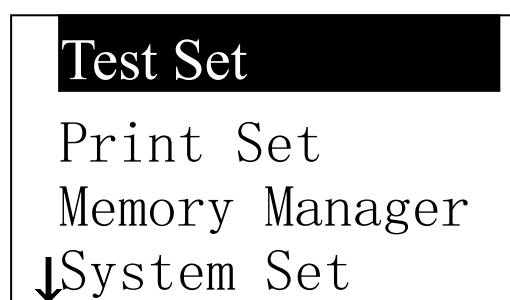
## 6.4 Menu Structure

Both presetting system parameters and the additional function could come true by 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 **【ETR】** 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

Impact Direc.  
Average  
Material  
Hardness Scale  
Tolerance Limit  
Hard/  $\sigma_b$ :Hard

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 **【ETR】** to confirm it.

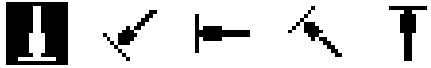
*Note: 1. When **【Hard/ $\sigma_b$ 】** is switched to  $\sigma_b$ , the hardness scale could not be selected. The cursor will skip over **【Hardness Scale】** while moves the cursor.*

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

### 6.5.1 Impact Direction Setting

Impact Direction

---



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

Press key **【ETR】** to confirm it.

Press key **【ESC】** to cancel it.

### 6.5.2 Average Times Setting

Mean Times

---

**0** 3

You could modify average times within the range of 1~32. Press key **【0】** ~ **【9】** to input the number value. The cursor will shift right around automatically when inputting.

Press key **【ETR】** to confirm it.

Press key **【ESC】** to cancel it.

### 6.5.3 Material Setting

When **【Hard/  $\sigma_b$ 】** 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.



↑ **Copper-Zinc**  
 Copper-Alumin  
 Wrought Copper  
 Wrought Steel

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

Press key **【ETR】** to confirm it.

Press key **【ESC】** to cancel it.

*Note 1. Presetting hardness scale recovers 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.

Mild Steel  
 High-C Steel  
 Cr Steel  
 ↓ **Cr-V Steel**

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

Press key **【ETR】** to confirm it.

Press key **【ESC】** to cancel it.

#### 6.5.4 Hardness Scale Setting

Hard of Material  
 -----  
**HL** HV HB HRC  
 HS HRB HRA

Press key **【◀】** or **【▶】** to move the cursor to the hardness scale you want to preset.

Press **【ETR】** to confirm setting.

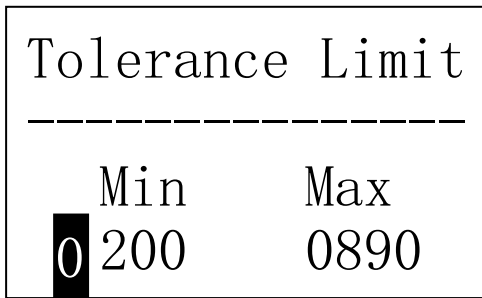
Press **【ESC】** to cancel setting.

*Note: 1. Here only displays the valid hardness scale for the present selected impact device and material. It would not display the hardness scale which is not valid.*

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

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

### 6.5.5 Tolerance Limit Setting



Press key **【0】** ~ **【9】** to input the number value. The cursor will shift right around automatically when inputting.

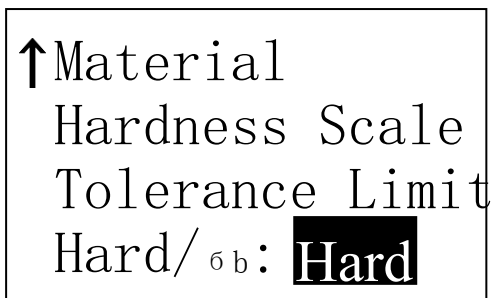
Press **【ETR】** to confirm setting.

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/ $\sigma_b$ Setting



Press key **【ETR】** to switch between Hard and  $\sigma_b$ .

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

## 6.6 Print Set

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

## 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

**【ETR】** into **【Memory Manager】** menu. If there is no data in the memory, displays: <No Data!>. Then return.

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

Press key【▲】or key【▼】to move the cursor to the function wanted, then press key 【ETR】 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  
-----  
001

Press the digit figure keys to input the number.

Press key 【ETR】 to start displaying memory data from the selected beginning group.

Press key 【ESC】 to cancel operation.

### 6.7.3 Data Transfer

【Transfer】 export the values stored in the memory as text format to PC through COM port.

### 6.7.4 Delete by Group No.

Select Group  
(001 to 010)  
Select Group  
From 001 to 010  
-----  
001

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

Press the digit figure keys to input the number.

Press key 【ETR】 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?	
-----	
<b>YES</b>	NO

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

Press key 【**◀**】 or 【**▶**】 to move the cursor to 【NO】 and press key 【ETR】 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

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

Press key 【ESC】 to exit browsing.

Press key 【ETR】 , then press 【**▲**】 or 【**▼**】 to move the cursor to the line which you want to see details. Press 【ETR】 to see details of that group.

<b>No. 001</b>	<b>12/03</b>	<b>514HL</b>
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 browse details including average value, test set and each single value.

Press 【ESC】 to return to previous display.


511	513	516	↑
514	515		

## 6.9 System Set

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

Test Set
Print Set
Memory Manager
↓System Set

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

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

Press key **【▲】** or key **【▼】** to move the cursor to the item wanted.  
Press key **【ETR】** 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  $3\sigma$  rule, could cancel gross error automatically after having measured presetting average times or pressing end in advance. If there is data canceled, it needs supplemental measure to reach presetting times.

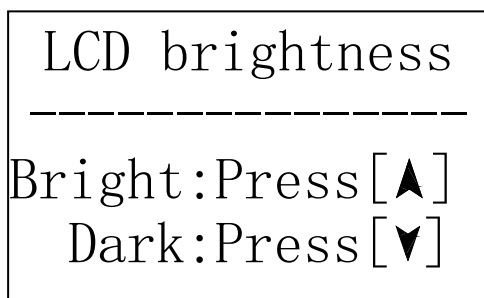
When **【Auto Trans.】** is set to <On>, could export the value of present group through

communication port after measuring and displaying average value.

When **【Key Sound】** is set to <On>, the buzzer would make a short hoot while press 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 buzzer would make a long hoot.

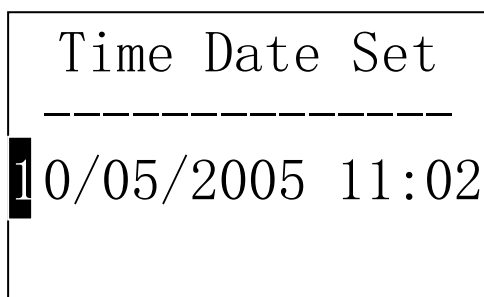
### 6.9.1 LCD Brightness Set



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

Press key **【ETR】** 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 (0~9) key to modify the present figure. The cursor will move automatically from left to right after modifying. Press key **【ETR】** 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 **【ETR】** into **【Software Info】** screen.

MH210  
Version:1.00  
Code:HL20000000  
SN:HL2000000000

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 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 **【ETR】** to power on the system. Then the software calibration screen shows as below.

Calibration  
-----  
0/5 times

Set the impact direction as **【↓】**. Measure 5 points on the standard hardness block.

Calibration  
-----  
Average=780  
Nominal=**780**

It would display the average value after measuring 5 times.

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

Press key **【ETR】** to confirm.

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

Range of adjustment:  $\pm 15HL$ .



## 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.

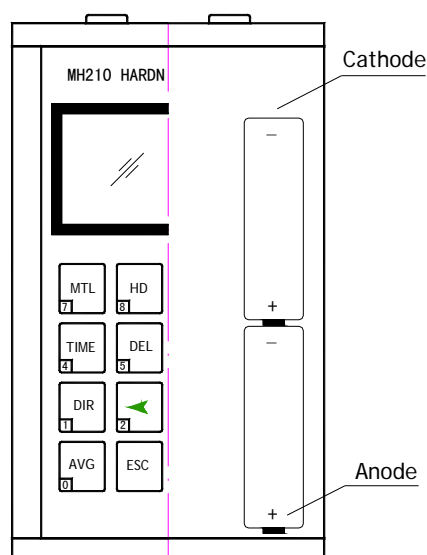
### 6.13 Auto Power Off

- 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 **【⏻】**, press any key could stop the twinkle 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.

### 6.14 Battery Replacing

Two AA size alkaline batteries are needed as the power source. After several hours' usage of the preset batteries, the battery symbol on the screen will be shown as . The more of dark part indicates the more close to fill. When the battery capacity runs out, the battery symbol will be shown as  and will glint. The batteries need to be replaced with the new ones then.

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



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

- Power down the instrument.
- Take off the circular cover of the battery and take out the two batteries.
- Insert the new batteries into the instrument.
- Reset the battery cover.
- Power on the instrument to check.

### 6.15 Connection of Data Transmission Cable

Insert one connection plug of transmission cable (Optional parts) into the socket on the upleft side of main body, and insert the another plug into the COM port in the back of computer box.



## 7 Fault Analysis & Evacuation

Fault Appearance	Fault Analysis	Handling method
Failure power on	Battery exhaustion	Replace the batteries
	Upside down of the battery positive /negative poles	Set right 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 is absolutely prohibited inside the impact device.

### 8.2 Normal Maintenance Program

When using standard Rockwell hardness block to testing, if all the error is bigger than 2 HRC, it may be the invalidation of impacted ball top caused by abrasion. Changing the spherical test tip or impact object should be considered.

When the hardness tester appears some other abnormal phenomena, please do not dismantle or adjust any fixedly assembled parts. Fill in and present the warranty card to us. The warranty service can be carried on.

## 9 Calibration

Calibration is needed every 1 year.

## 10 Notice of Transport and Storage Conditions

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

## 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-zinc alloys)	HB	40~173					
	HRB	13.5~ 95.3					
BRONZE(copper-aluminum/tin alloys)	HB	60~290					
Wrought copper alloys	HB	45~315					

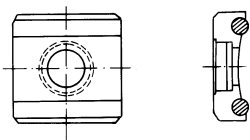
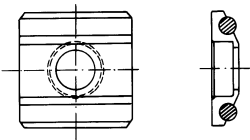
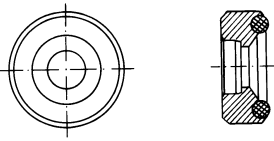
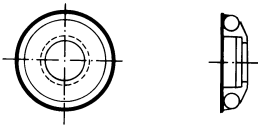
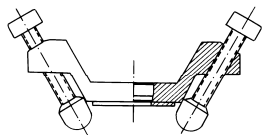
**Table 2**

No.	Material	HLD	Strength $\sigma_b$ (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:	1.6 μ m	1.6 μ m	0.4 μ m	6.3 μ m	1.6 μ m	
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	24 μ m	24 μ m	12 μ m	53 μ m	24 μ m
Hardness 600HV	Indentation diameter	0.54mm	0.54mm	0.32mm	0.90mm	0.54mm
	Depth of indentation	17 μ m	17 μ m	8 μ m	41 μ m	17 μ m
Hardness 800HV	Indentation diameter	0.35mm	0.35mm	0.35mm	--	0.35mm
	Depth of indentation	10 μ m	10 μ m	7 μ m	--	10 μ m
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~ $\infty$