

# **MH100 Leeb Hardness Tester**

## **User's Manual**



**Mitech CO., LTD**

1 OVERVIEW .....	3
1.1 Advantages.....	3
1.2 Main Application & Testing Range.....	4
1.2.1 Main Application .....	4
1.2.2 Testing Range.....	4
1.3 Technical Specifications.....	5
1.4 Configuration.....	6
1.5 Working Conditions.....	6
1.6 Safety Instructions.....	7
2 STRUCTURE FEATURE & TESTING PRINCIPLE.....	8
2.1 Structure Feature .....	8
2.1.1 The Hardness Tester Appearance.....	8
2.1.2 D Type Impact Device.....	8
2.1.3 Different Types of Impact Device .....	9
2.2 Main Screen .....	9
2.3 Keypad Definitions .....	10
2.4 Leeb Hardness Testing Principle .....	10
3 PREPARATION.....	11
3.1 Instrument Preparation and Inspection .....	11
3.2 Preparation of the Sample Surface .....	12
4 TESTING PROGRAM .....	14
4.1 Start-Up .....	14
4.2 Loading.....	14
4.3 Localization .....	14
4.4 Testing.....	14
4.5 Read Measured Value.....	16
4.6 Notification.....	16

5 OPERATION DETAIL.....	17
5.1 Power On/Off.....	17
5.2 Material Setting.....	17
5.3 Hardness/Strength testing switch.....	18
5.4 Hardness Scale Setting.....	19
5.5 Impact Direction Setting.....	19
5.6 Average Times Setting.....	19
5.7 Saving testing result.....	19
5.8 Data logging.....	20
5.9 System Reset.....	21
5.10 EL Backlight.....	21
5.11 Auto Powering Off.....	21
5.12 Battery Charge.....	22
5.13 Connecting to a Computer.....	22
5.14 Error Code Reference.....	23
6 MAINTENANCE & SERVICING.....	23
6.1 Impact Device Maintenance.....	23
6.2 Instrument Maintenance Program.....	23
6.3 Fault Analysis & Evacuation.....	24
6.4 Notice of Transport and Storage Conditions.....	24
APPENDIX.....	25
Table 1.....	25
Table 2.....	26
Table 3.....	27
Table 4.....	28

# 1 Overview

## 1.1 Advantages

- Compact and integrated. The impact device and the main body integrated together.
- Wide measuring range. Based on the principle of Leeb hardness testing theory. It can measure the Leeb hardness of all metallic materials.
- Large screen LCD, showing all functions and parameters. With EL background light.
- Test at any angle, even upside down.
- Direct display of hardness scales HRB, HRC, HRA, HV, HB, HS, HL.
- Large memory could store 100 groups (Relative to average times 32~1 ) information including single measured value, mean value, impact direction, impact times, material and hardness scale etc.
- Battery information showing the rest capacity of the battery and the charge status.
- User calibration function.
- Software to connect to PC via USB port.
- Li-Ion rechargeable battery as the power source. Charge circuit integrated inside the instrument. Continuous working period of no less than 200 hours (EL off and no printing).
- Auto power off to save energy.
- Outline dimensions: 148mm×33mm×28mm

## **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**

The model includes D type, C type and DL type according to the impact device.

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

### 1.3 Technical Specifications

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

Table 1-1

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	DL	878±30HLDL 736±40HLDL	±12 HLDL	12 HLDL
3	C	822±30HLC 590±40HLC	±12 HLC	12 HLC

- Measuring range: HLD (170~960) HLD
- Measuring direction: 0°~360°
- Hardness Scale: HL、HB、HRB、HRC、HRA、HV、HS
- Display: segment LCD
- Data memory: 100 groups max. (relative to impact times 32~1)
- Battery: 3.7V Li-Ion, Rechargeable
- Battery charger: 5V/500mA
- Continuous working period: about 200 hours (With backlight off, no printing)
- Communication interface: USB1.1

## 1.4 Configuration

Table 1-2

	No.	Item	Quantity	Remarks
Standard Config.	1	Main unit	1	D type, C type and DL type optional
	2	Standard test block	1	
	3	USB cable	1	For comm. And charging
	4	Battery Charger	1	5V 500mA
	5	Cleaning brush I	1	
	6	Small support ring	1	
	7	Li-Ion battery	1	
	8	Manual	1	
	9	DataPro software	1	
	10	Instrument package case	1	
Optional Config.	11	Other type of impact devices and support rings		Refer to Table 3 and Table 4 in the appendix.
	12			

## 1.5 Working Conditions

Working temperature:  $-10 \sim +50$  ;

Storage temperature:  $-30 \sim +60$  ;

Relative humidity:  $\leq 90\%$ ;

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

## **1.6 Safety Instructions**

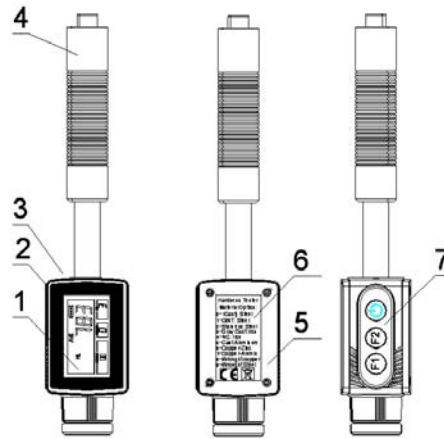
- The instrument can only work with the specially designed battery pack and power adapter (charger) supplied by Mitech Co. LTD. Working with others may result in damage of the instrument, battery leakage, fire or even explosion.
- Do not cast the battery pack into fire and do not short circuit, disassemble or heat the battery pack, otherwise battery leakage, fire or even explosion may occur.



## 2 Structure Feature & Testing Principle

### 2.1 Structure Feature

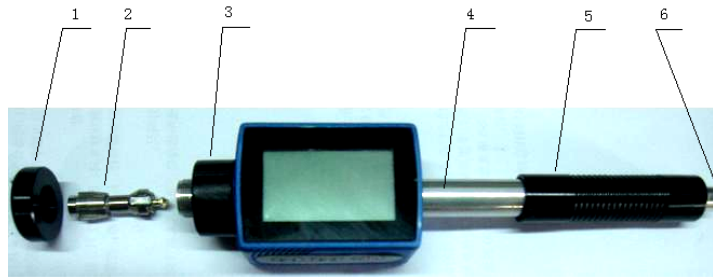
#### 2.1.1 The Hardness Tester Appearance



1 LCD display 2 Main unit 3 Socket of USB 4 Impact device

5 Battery compartment cover 6 Product label 7 Keypad

#### 2.1.2 D Type Impact Device



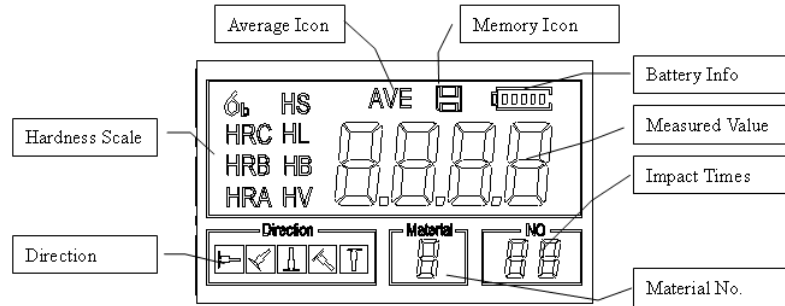
- 1 Support ring    2 Impact body    3 Coil unit    4 Guide tube
- 5 Loading tube    6 Release button

### 2.1.3 Different Types of Impact Device

The instrument has three types: type D, type C and type DL depending on different impact device. Please refer to Table 1 and Table 3 for details.

## 2.2 Main Screen

Below is the main display screen:



Instruction of the Main Display Screen:

**Material:** The present presetting material.

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

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

**Battery information:** Showing the rest capacity of the battery and the charging status.

**Measured value:** Display present single time measured value (without showing average icon), or display the present mean value (with average icon prompting). “-HI-” means over conversion value or


measure range. “-LO-” means lower than conversion value or measure range.


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

**Average Icon :** It will appear when showing the mean value of the measured values after reaching the presetting impact times.

**Memory Icon :** It appears when operating the instrument memory.

### 2.3 Keypad Definitions

The instrument has three keys: 、 F1 and F2.

Key  - Turning on/off the instrument.

Key F1 and F2 – Selecting or modifying the instrument parameters.

Key actions:

Short-press: Press on a key lasting for not more than one second.

Long-press: Press on a key lasting for more than one second

### 2.4 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

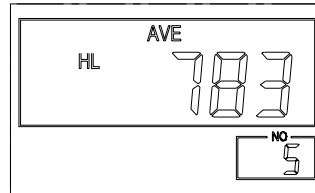
VA—— Impacting velocity of the impact body

## 3 Preparation

### 3.1 Instrument Preparation and Inspection

Verification of the instrument is by using standard test block. The error and repeatability of displayed value should be within the regulation of Appendix table 2. The instrument and impact device must be calibrated using a standard hardness block before use as the first time, or having not been used for a long time, or having reset the instrument system.

Press  key, meanwhile pressing down the F1 key to power on the system. Then the user calibration screen shows as right.



Test for 5 points on the standard hardness block. It would display the average measured value after measuring 5 times. Short-press F1 to increase or F2 to decrease the digit to its nominal value.

Long-press F1 to confirm the calibration finally. Or long-press F2 to cancel the calibration.

Range of adjustment:  $\pm 30\text{HL}$ .

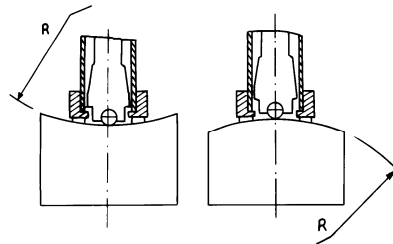
The measurement parameters, including the material setting, the hardness scale and the impact direction can't be changed during calibration.

**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 user calibration to adjust.

### 3.2 Preparation of the Sample Surface

Preparation for sample surface should conform to the relative requirement in 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 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 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, 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 Testing Program

### 4.1 Start-Up

Press the  key to start up the instrument. The instrument then comes into working mode.

### 4.2 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.



### 4.3 Localization

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

### 4.4 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 3 to 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 groups 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	3	5
DL	3	5
C	2	4



#### **4.5 Read Measured Value**


After each impact operation, the LCD will display the current measured value, impact times plus one, the buzzer would alert a long howl if the measured value is not within the valid range. 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 measured value.


#### **4.6 Notification**

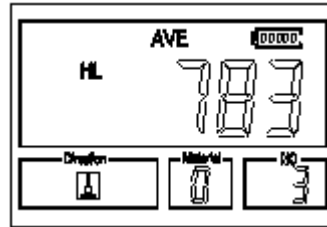
- You could not save the current test value if the impact time is less than the presetting times value.
- Only type D of the impact device has the function of strength test option. You can not change the setting to strength testing when using the instrument with other types of impact device.
- Not all materials could convert to all hardness scale value. The hardness scale is reset to HL automatically after changing the material. So select material firstly before changing the hardness scale.

## 5 Operation Detail

### 5.1 Power On/Off

Press  to turn on the instrument. The system would automatically detect the type of the impact device during power up, and would display this information on the screen. After pausing for several second, the screen will exit and enter the main display screen as following:

The instrument can be turned off by pressing the  key while it is working. The tool has a special memory that retains all of its settings even when the power is off.



*Note: If the instrument is in power off condition, it will turns on automatically after the charge power is connected.*

### 5.2 Material Setting

Short-press F1 key several times to select MTL option. Then short-press F2 to change the material to the one you want to set. Hardness scale recovers to HL automatically after material setting is changed. Please select material firstly, then select hardness scale.

In hardness testing mode, you can select the material among the following materials: 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. The relationship between the material index number displayed on the instrument screen and the material is

as follows:

TABLE 5-1

Index	MATERIAL	Index	MATERIAL
0	Steel and cast steel	5	Cast aluminum alloys
1	Cold work tool steel	6	Copper-Zinc alloys
2	Stainless steel	7	Copper –Aluminum alloys
3	Gray cast iron	8	Wrought copper
4	Nodular cast iron	9	Wrought steel

In strength testing mode, the following materials are selectable: 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. The relationship between the material index number displayed on the instrument screen and the material is as follows:

TABLE 5-2

Index	MATERIAL	Index	Material
0	Mild steel	5	Cr-Mo steel
1	HIGH CARBON STEEL	6	Cr-Ni-Mo steel
2	Cr steel	7	Cr-Mn-Si steel
3	Cr-V steel	8	Super strength steel
4	Cr-Ni steel	9	Stainless steel

### 5.3 Hardness/Strength testing switch

Long-press F1 key to switch between hardness testing and strength testing (6b) .

*Note: Only the D type instrument has the function of strength testing. So hardness testing is the only selection if the instrument is not D type.*

In hardness testing mode, the supported hardness scale includes: HL, HV, HB, HRC, HS, HRB and HRA.

**Note :**

- *Here only displays the valid hardness scale for the present selected material. It would not display the hardness scale which is not valid.*
- *Please select material firstly, then select hardness scale.*
- *Presetting hardness scale recovers to HL automatically after presetting material is changed.*

#### **5.4 Hardness Scale Setting**

Short-press F1 several times to select hardness scale item. The hardness scale currently using will begin to flash. Then short-press F2 to change the hardness scale to the one you want to set.

#### **5.5 Impact Direction Setting**

Short-press F1 several times to select the DIR item. Then short-press F2 to change the impact direction to what you want to set.

#### **5.6 Average Times Setting**

You could modify average times within the range of 1 to 32 as following:

Short-press F1 several times to select the NO item. Then short-press F2 to set the average times to the number you want.

#### **5.7 Saving testing result**

By simply short-pressing F2 after a new measurement finishes-the screen showing the “AVE” icon, the measured hardness/strength group values will be saved to memory. The newly saved file is appended as the last file of the memory.

At most one hundred files (F00-F99, one group as one file) can be stored inside the tester.

## **5.8 Data logging**

This function provides the user with the ability to view/delete a file/group previously saved in memory.

### **Viewing stored file/Group**

To view the memory data, follow the steps:

- 1) Long-press F2 to activate the data logging function. The memory icon will appear. The instrument will display the current file name, the test parameter of the group data and the mean value of the group. If there is no data in the memory, it will display: <E04>, which means no memory data, and then return back.
- 2) Short-press F1 and F2 to select the desired file to view.
- 3) Long-press F1 to see details of that group data.
- 4) Short-press F1 and F2 to view each single measured data in that group while viewing details.

### **Deleting selected file/Group**

The user may require deleting a file from the instrument memory. The procedure is outlined in the following steps.

- 1) Long-press F2 to activate the data logging function. The memory icon will appear. It will display the current file name, the test parameter of the group data and the mean value of the group. If there is no data in the memory, it will display: <E04>, which means no memory data, and then return back.
- 2) Short-press F1 and F2 to scroll to the file that will be deleted.
- 3) Long-press F2 on the desired file. It will automatically delete the file, and display “-DEL”.

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

## **5.9 System Reset**


Press down F2 while powering on the instrument will restore factory defaults. The only time this might possibly helpful is if the parameter in the instrument was somehow corrupted.

## **5.10 EL Backlight**

With the EL background light, it is convenient to work in the dark condition. Pressing any key will switch on the background light at any moment after powering on. Since the EL light will consume much power, turn on it only when necessary.

The EL background light will be automatically switched off when the instrument lasts three seconds of no key or testing operation.


## **5.11 Auto Powering Off**



The instrument features an auto powering off function designed to conserve battery life. If the tool is idle (neither measuring nor any key operation) for 5 minutes, it will turn itself off. Before powering off, the LCD display of the instrument will continue flashing for 20 seconds. Except pressing , 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 display will show <E00>, then power off automatically.

When the instrument is being charged, the Auto Power Off will not function.

## 5.12 Battery Charge

The instrument uses a Rechargeable battery as its power source. When the battery almost runs out, the battery symbol on the display will glint . It needs charging as soon as possible. Try to drain your battery pack as fully as possible before it is charged for longer battery service.

- Plug the power adapter into the mains supply power socket. Then plug one end of the USB cable into the USB port of the instrument and the other end to the adapter. If the instrument is in power off condition, it will turn on automatically after the USB cable is inserted into the adapter. The battery symbol will alternately show between  and  when charging. The more of the dark part indicates the more close to full capacity.
- When the battery is fully charged, the charging process will be automatically stopped.
- Please use the configured AC-DC adapter to charge the battery.

*An alternative charging method is connecting the instrument to PC via the USB cable.*

## 5.13 Connecting to a Computer

Insert one connection plug of the USB cable into the USB socket on the top side of main body, and insert the other plug into the USB port of the PC. Refer to the manual of the DataPro software for detailed information.

## 5.14 Error Code Reference

Error Code	Explanation
E00	Battery exhausted
E01	Value out of range
E02	Measurement not finished
E03	Data already saved
E04	No memory data

## 6 Maintenance & Servicing

### 6.1 Impact Device Maintenance

- 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.

### 6.2 Instrument 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.



### **6.3 Fault Analysis & Evacuation**

Fault Appearance	Fault Analysis	Handling method
Charge failure	Battery failure	Replace the battery with a new pack
	Charger failure	Replace the charger
No measured value	Impact device failure	Return for repairment
Failure power on	Battery exhaustion	Charge the battery

### **6.4 Notice of Transport and Storage Conditions**

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

## APPENDIX

**Table 1**

Material	Method	Impact device		
		D	C	DL
Steel and cast steel	HRC	20~68.5	20.0~ 69.5	20.6 ~ 68.2
	HRB	38.4~ 99.6		37.0 ~ 99.9
	HRA	59.1~ 85.8		
	HB	127~651	80~683	81~646
	HV	83~976	80~996	80~950
	HS	32.2~ 99.5	31.8~ 102.1	30.6~ 96.8
Cold work tool steel	HRC	20.4~ 67.1	20.7~ 68.2	
	HV	80~898	100~941	
Stainless steel	HRB	46.5~ 101.7		
	HB	85~655		
	HV	85~802		
Grey cast iron	HRC			
	HB	93~334		
	HV			
Nodular cast iron	HRC			
	HB	131~387		
	HV			
Cast aluminum alloys	HB	19~164	23~210	
	HRB	23.8~ 84.6	22.7~ 85.0	
BRASS(copper-zi	HB	40~173		

nc alloys)	HRB	13.5~ 95.3		
BRONZE(copper- aluminum/tin alloys)	HB	60~290		
Wrought copper alloys	HB	45~315		

**Table 2**

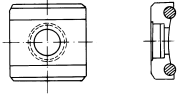
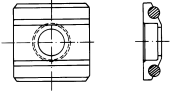
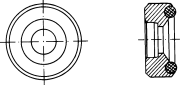
No.	Material	HLD	Strength $\sigma_b$ (MPa)
1	Mild steel	350~522	374~780
2	High-Carbon steel	500~710	737~1670
3	Cr steel	500~730	707~1829
4	Cr-V steel	500~750	704~1980
5	Cr-Ni steel	500~750	763~2007
6	Cr-Mo steel	500~738	721~1875
7	Cr-Ni-Mo steel	540~738	844~1933
8	Cr-Mn-Si steel	500~750	755~1993
9	Super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


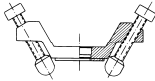
**Table 3**

Type of impact device		D/DL	C
Impacting energy		11mJ	2.7mJ
Mass of impact body		5.5g/7.2g	3.0g
Test tip hardness:		1600HV	1600HV
Dia. Test tip:		3mm	3mm
Material of test tip:		Tungsten carbide	Tungsten carbide
Impact device diameter:		20mm	20mm
Impact device length:		86(147)/ 75mm	141mm
Impact device weight:		50g	75g
Max. hardness of sample		940HV	1000HV
Mean roughness value of sample surface Ra:		1.6 $\mu$ m	0.4 $\mu$ m
Min. weight of sample:			
Measure directly		>5kg	>1.5kg
Need support firmly		2~5kg	0.5~1.5kg
Need coupling tightly		0.05~2kg	0.02~0.5kg
Min. thickness of sample			
Coupling tightly		5mm	1mm
Min. layer thickness for surface hardening		$\geq$ 0.8mm	$\geq$ 0.2mm
Size of tip indentation			
Hardness 300HV	Indentation diameter	0.54mm	0.38mm
	Depth of indentation	24 $\mu$ m	12 $\mu$ m
Hardness 600HV	Indentation diameter	0.54mm	0.32mm
	Depth of indentation 压痕深度	17 $\mu$ m	8 $\mu$ m
Hardness 800HV	Indentation diameter	0.35mm	0.35mm

	Depth of indentation	10μm	7μm
Available type of impact device		DC: Test hole or hollow cylindrical; DL: Testslender narrow groove or hole	C: Test small, light, thin parts and surface of hardened layer

**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 adjustable R10~∞

**Mitech CO., LTD.**

**Address: Room E506B, YingChuangDongLi Park, 1# of  
ShangDi East Road, Haidian District, Beijing, China**

**Tel: 86-10-51284068**

**Fax: 86-10-58859527**

**PC : 100085**

**Web: [www.mitech-ndt.com](http://www.mitech-ndt.com)**