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# 1.Principle of Leeb hardness testing method

The impact body, which is equipped with tungsten carbide, impacts into the work piece and rebounds back. The rebound and impact velocities are measured at the 1mm point from the work piece in the following way: the integrated permanent magnet will produce directly proportional voltage with the impact velocity. The Leeb hardness values are calculated by the following formula:

$$HL=1000 \times (V_b / V_a)$$

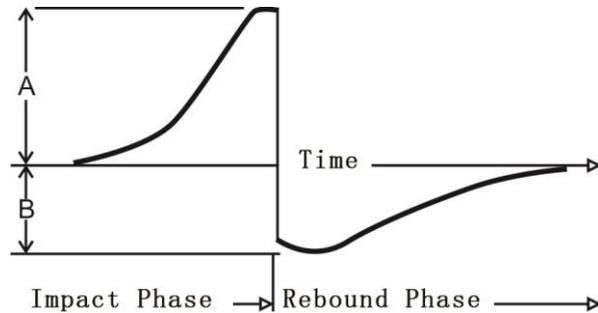
In Which: HL: Leeb hardness values

$V_b$  : the voltage produced during the rebound of impact body

$V_a$  : the voltage produced during the impact of impact body

Figure 1 shows the voltage produced during the impact and rebound of impact body:

Figure 1 voltage features of output signal



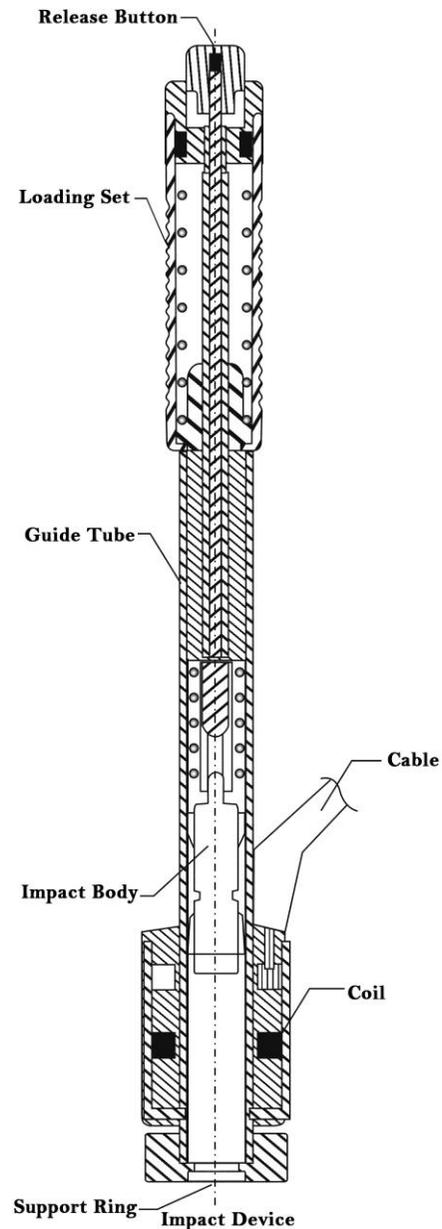
The Leeb hardness values can be converted to other hardness scales directly, such as HV, HRC, HRB, HB and HS.

# 2. Summary

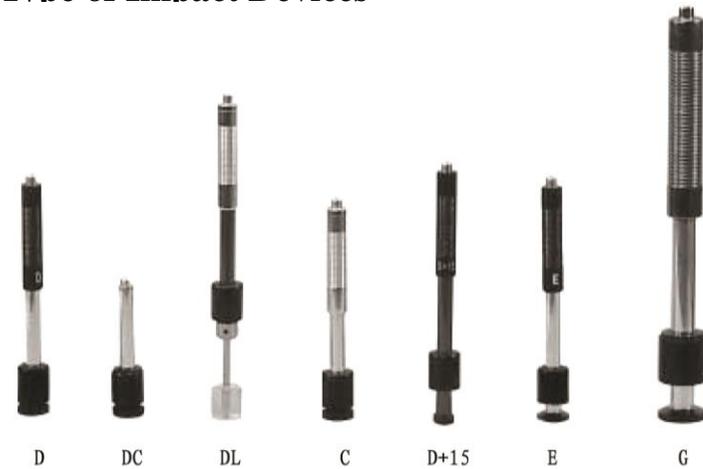
## 2.1 LM-100



## 2.2 D type impact device



## 2.3 Type of Impact Devices



## 2.4 Impact Devices Specification:

Special Impact Device	D/DC/DL	D+15	C	G	E
Impact Energy	11mJ	11mJ	11mJ	11mJ	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
Test Tip Diameter	3mm	3mm	3mm	5mm	3mm
Test Tip Material	Tungsten carbide				
Impact Device Diameter	20mm	20mm	20mm	30mm	20mm
Impact Device Length	86/147/75mm	162mm	141mm	254mm	155mm
Impact Device Weight	50g	80g	75g	250g	80g
Max. Hardness of Sample	940HV	940HV	1000HV	650HV	1200HV
Average surface roughness Ra:	1.6 μm	1.6 μm	0.4 μm	6.3 μm	1.6 μm
Min. Weight of Sample:	>5kg	>5kg	>1.5kg	>15kg	>5kg
Of compact shape	2~5kg	2~5kg	0.5~1.5kg	5~15kg	2~5kg
On solid support	0.05~2kg	0.05~2kg	g	0.5~5kg	0.05~2kg
Coupled on plate			0.02~0.5kg		
Min. thickness of sample:	5mm	5mm	1mm	10mm	5mm

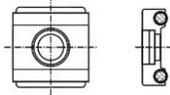
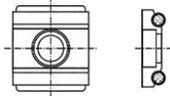
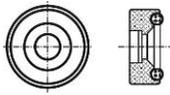
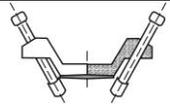
Coupled Min. thickness of layers		» 0.8mm	» 0.8mm	» 0.2mm	» 1.2mm	» 0.8mm
Indentation of test tip						
With 300HV	Diameter	0.54mm	0.54mm	0.38mm	1.03mm	0.54mm
	Depth	24 μm	24 μm	12 μm	53 μm	24 μm
With 600HV	Diameter	0.54mm	0.54mm	0.32mm	0.90mm	0.54mm
	Depth	17 μm	17 μm	8 μm	41 μm	17 μm
With 800HV	Diameter	0.35mm	0.35mm	0.35mm	--	0.35mm
	Depth	10 μm	10 μm	7 μm	--	10 μm
Impact Device applicable scope	DC used for very confined spaces such as holes, cylinders, internal measurement. DL used for extremely confined spaces.	D+15 for measuring in grooves, recessed surface.	C used for testing hardened or thin walled components.	G used for solid heavy component, such as rough castings and forgings.	E used for high hardness material.	

## 2.5 Standard delivery:

- ◆ LM100 main unit
- ◆ D type impact device
- ◆ HLD value Standard Calibration Block
- ◆ DataView software
- ◆ USB Communication cable
- ◆ Small supporting ring
- ◆ Cleaning brush
- ◆ User`s manual
- ◆ Protective Rubber case
- ◆ Suitcase

## 2.6 Optional accessories:

- ◆ Impact device DC/C/DL/D+15/G
- ◆ Standard Calibration Test Block
- ◆ Blue tooth module & Thermal Printer
- ◆ Standard supporting ring
- ◆ Small Supporting ring
- ◆ Special supporting rings (see following table)

No.	Code	Model	Special Support Ring Sketch	Notes
1	03-03.7	Z10-15		Measure outside the cylindrical surface R10~R15
2	03-03.8	Z14.5-30		Measure outside the cylindrical surface R14.5~R30
3	03-03.9	Z25-50		Measure outside the cylindrical surface R25~R50
4	03-03.10	HZ11-13		Measure inside the cylindrical surface R11~R13
5	03-03.11	HZ12.5-17		Measure inside the cylindrical surface R12.5~R17
6	03-03.12	HZ16.5-30		Measure inside the cylindrical surface R16.5~R30
7	03-03.13	K10-15		Measure outside the spherical surface SR10~SR15
8	03-03.14	K14.5-30		Measure outside the spherical surface SR14.5~SR30
9	03-03.15	HK11-13		Measure inside the spherical surface SR11~SR13
10	03-03.16	HK12.5-17		Measure outside the spherical surface SR12.5~SR17
11	03-03.17	HK16.5-30		Measure outside the spherical surface SR16.5~SR30
12	03-03.18	UN		Measure outside the cylindrical surface, adjustable radius R10~∞

### 3. Functions and Applications

#### 3.1 Technical Specifications

Measuring Method: Leeb Hardness Testing method

Hardness Scale: HL, HB, HRB,HRC,HV,HS,  $\sigma_b$ .

Measuring Range : HLD (200-960) HRC (19.8-68.5) HB (30-651) HV (80-976) HS (26.4-99.5) HRB (13.5-100)  $\sigma_b$  (375-2639).

Impact device: D type impact device (Standard); Optional C/G/DC/DL/D+15

Accuracy:  $< \pm 6\text{HLD}$  (HLD=800), Repeatability  $6\text{HLD}$  (HLD=800)

Measuring direction: 360 degree by manual setting

Material : Steel& Cast Steel, Stainless Steel, GC IRON, NC IRON, Cast

Aluminum alloy, Macht metal, Copper-tin alloy, Brass

Resolution: 1HL, 1HV, 1HB, 0.1HRB, 0.1HRC, 0.1HS

Display: LED with backlight.

Memory: 100 groups (each group include 1-7 testing result and 1 AVE value)

Communication: USB port (Standard) and Blue tooth (Optional)

Printer: Thermal Printer with blue tooth (optional)

Power: 2 AA batteries

Working temperature:  $-10^{\circ}\text{C} \sim +50^{\circ}\text{C}$

Size:  $153 \times 76 \times 37$  (mm) (H×W×D)

Weight: 280g include batteries

Standard: GB/T 17394-2014, ASTM A956

Warranty: 12 months after purchase

#### 3.2 Applications

Installed machinery and Permanent assembly parts

Mould cavity

Heavy workpieces

Failure analysis of pressure vessel, turbine and other equipments

Small test area

The production line of Bearings and other parts

Distinguish the material of the metal material warehouse

### 4 .Pre-Treatment of Workpiece

#### 4.1 Workpiece Requirements

##### 4.1.1 Surface Roughness requirements

Surface roughness is an important requirement for the surface of the test piece, it should be smooth and no oil, or will cause measurement errors.

The surface roughness requirements are listed in table 4.1

Impact Device Type	Work piece surface roughness Ra
D, DC, D+15	2um
G	7um
C	0.4um

##### 4.1.2 Weight and Thickness Requirements

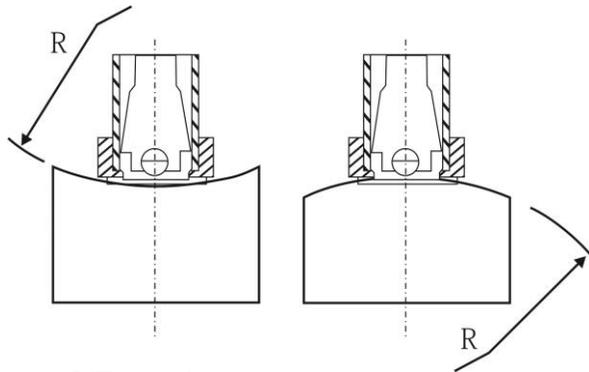
Impact device type	Min weight	Min thickness (no coupling)	Min thickness (coupling)
D、DC、D+15	5kg	25mm	3mm
G	15kg	70mm	10mm
C	1.5kg	10mm	1mm

##### 4.1.3 Surface Hardened Layer

Impact device	Min. depth of surface hardened layer (mm)
D, DC, D+15	0.8
C	0.2

##### 4.1.4 Curved surface Requirement

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 special support rings should be chosen.

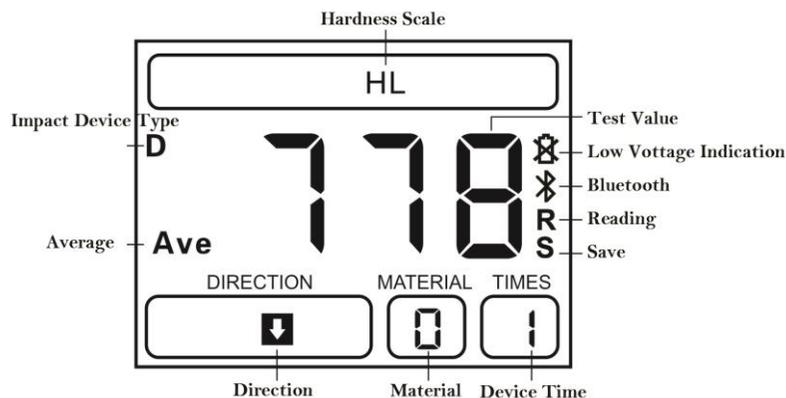


## 4.2 Support of Test piece

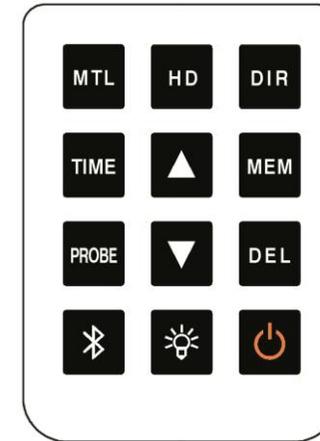
- ◆ The heavy workpiece do not need support
- ◆ The Mid-heavy workpiece must be placed on a flat, sturdy surface, and absolutely smooth placement, without any shaking.
- ◆ Light workpiece must be tightly coupled with the solid support body, the coupling surface must be smooth, and Coupled dosages don't too much, Test direction must be perpendicular to the coupling surface.
- ◆ When the workpiece is a large area of Sheet, Pole and Bending Parts, Even if a large weight and thickness may still cause deformation, so reinforcement and support in the rear surface of the test point is necessary.

## 5. Operation

### 5.1 Display



### 5.2 Keyboard



### 5.3 Turn on the instrument

Press  to power on the LM100, the screen will display the default interface for the first time, then power on again will display the last parameters automatically,

### 5.4 Parameters Setting

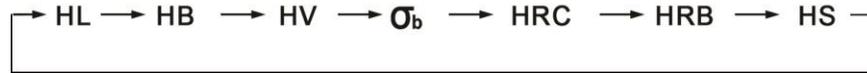
#### 5.4.1 Material

Press "MTL" button to choose the material, code no. from 0-8:

Code	Hardness	Tensile strength
0	Steel and Cast Steel	C
1	GC. IRON	CrNi
2	NC. IRON	CrMo
3	C. ALUM	CrV
4	BRASS	CrMnSi
5	BRONZE	SSST
6	COPPER	SST
7	SST	CrNiMo
8	Forging Steel	Cr
9	Alloy tool steel	

### 5.4.2 Hardness Scale

Press “HD” to choose the Hardness scale and strength:

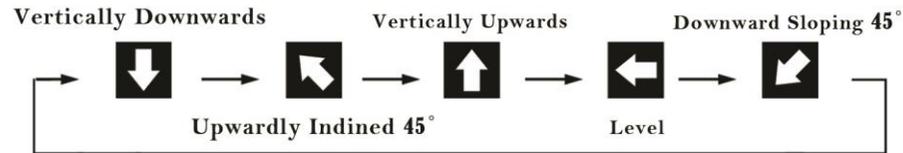


### 5.4.3 Impact devices

Press “Probe” button to select probes.

### 5.4.4 Impact Direction

Press “DIR” button to select impact direction



### 5.4.5 Average times

It is very necessary to work out the average measuring values in hardness testing. Different measuring times between 1-7 can be selected according to user`s different requirements

Press “TIME” button to set the impact times from 1-7 which will calculate the AVE value after the certain times.

## 5.5 Measuring

### 5.5.1 Operating

After finish the parameters setting, then start measuring:

- ◆ Load the impact body: Pushing the loading-tube until contact is felt. Then allow it to slowly return to the starting position locking the impact body.
- ◆ Press the impact device support ring firmly on the surface of the sample, the impact direction should be vertical to the testing surface.
- ◆ 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.



图 (1)



图 (2)



图 (3)

- ◆ After testing, the tester will display as following:



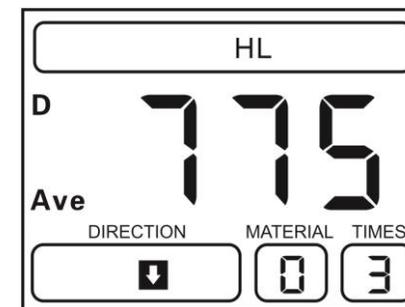
### 5.5.2 Reject the Gross Error Value

During the measuring process, if the deviation between the measured value and standard value is too big before the mean value displaying, the current measured value can be deleted by press “DEL” button, and the current value would be neither stored nor in averaging, the impact times minus one.

## 5.6 Average value

When the impact times reach the setting parameter “TIME”, then the tester will display the following average value and will show the symbol “Ave”

3-5 times is usually used in normal measurement



## 5.7 Data saving and read settings

### 5.7.1 Storage testing result

Press “MEM” button to set the saving function, the “S” symbol will be showed

on the screen.

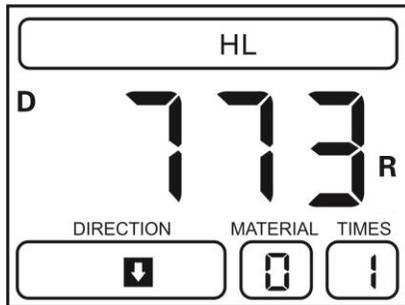
The tester will save testing results automatically, including 7 testing results and 1 average value each group, and total 100 groups can be stored.

Note: Please store the data by pressing the “MEM” key before the average value is displayed in the current group test.

### 5.7.2 Reading

In saving status, press and hold the “MEM” button to enter the reading mode and the symbol “R” will be showed on the display. At the same time, the first impact value in the recently saved groups will be displayed, press “up” and “down” button to read the saved testing value.

Then press (or long press) “MEM” to quit the storage function, and the symbol “R” disappears.



### 5.7.3 Delete

Press “DEL” button in reading mode to delete one group data. Long press “DEL” button to delete all stored values.

### 5.7.4 Data Transmission

The data in stored can be transferred from the instrument to a PC via communication software, to save, statistic and analyze the measurement. (See the help documentation in communication software for details)

## 5.8 Blue tooth and print (Optional)

Press “Blue Tooth” button to connect with the Thermal Printer then the groups testing data will be printed.

## 5.9 Calibration (Error-correction settings)

Measuring error can be usually caused by test tip abrasion or changing another impact device. So it is necessary to correct the error to make the measurement accurate.

Press “up” and “down” button at the same time after power on, then the tester will enter calibration mode, the identification of calibration  appears. Impact the standard block continuously until get the average values, then press “up” and “down” button to adjust the value to the standard value, finally press the store button to finish the calibration, the tester will save the cal data and exit the calibration mode.

If you want to give up the calibration suddenly, please press the “power off” button directly in Calibration mode.

## 6. Maintenance & servicing

After long time using, the impact device has been used for 1000-2000 times, please use the cleaning brush to clean the tube and impact body.

- ◆ unscrew the support ring first, then take out the impact body;
- ◆ Spiral the nylon brush in counter-clock direction into the bottom of the tube and take it out for 5 times
- ◆ Install the impact body and support ring.
- ◆ Release the impact body after use.
- ◆ Any lubricant is absolutely prohibited inside the impact device.