

# **Leeb Hardness Tester**

**LM100**

**Operating Manual**

**YUSHI INSTRUMENTS**

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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:

voltage features of output signal

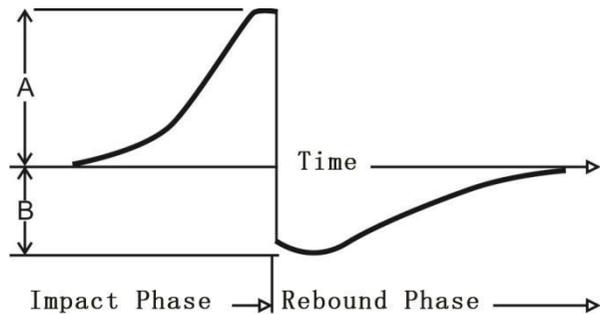


Figure 1.1

# 2. Instrument and Impact Device Diagram

## 2.1 Instrument Diagram



Figure 2.1

## 2.2 D Type Impact Device Diagram

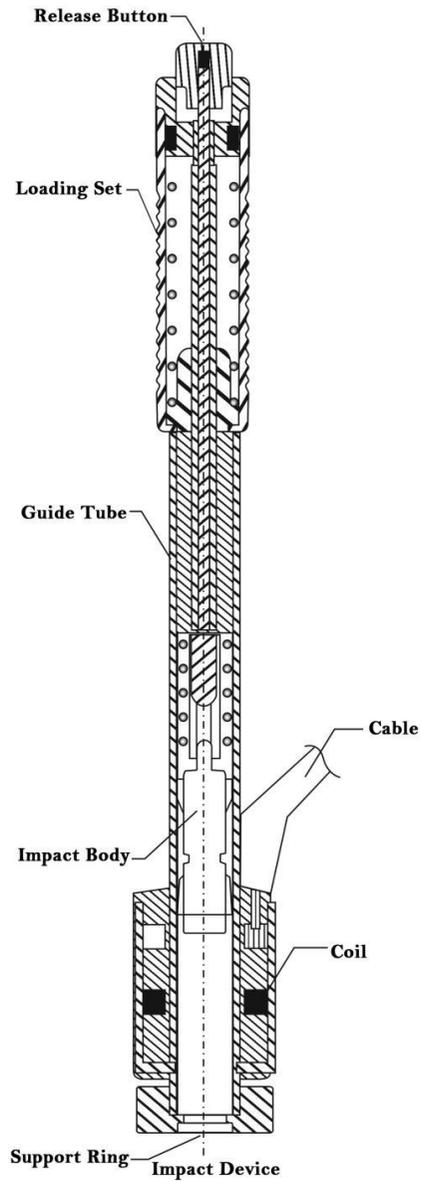


Figure 2.2

## 2.3 Types of Impact Device

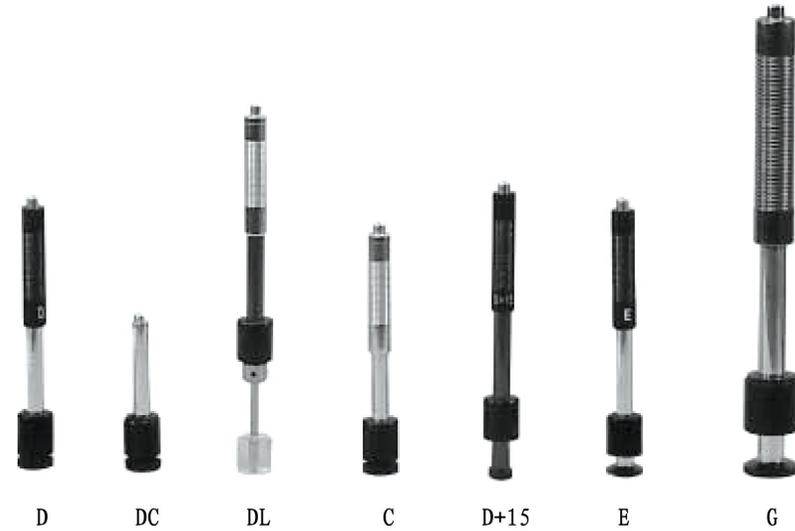


Figure 2.3

## 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	86/147/75	162mm	141mm	254mm	155mm
Impact Device Weight	50g	80g	75g	250g	80g
Max. Hardness of Sample	940HV	940HV	1000HV	650HV	1200HV

<b>Average Surface Roughness Ra:</b>		1.6 μ m	1.6 μ m	0.4 μ m	6.3 μ m	1.6 μ m
<b>Min. Weight. of Sample: (kg)</b>						
<b>Directly Measurable</b>	>5	>5	>1.5	>15	>5	
<b>Need Stable Support</b>	2-5	2-5	0.5-1.5	5-15	2-5	
<b>Tightly Coupled</b>	0.05-2	0.05-2	0.02-0.5	0.5-5	0.05-2	
<b>Min. Thickness. of Sample:</b>						
<b>Tightly Coupled</b>	5mm	5mm	1mm	10mm	5mm	
<b>Min. Depth. of Hardnes Layers</b>	» 0.8mm	» 0.8mm	» 0.2mm	» 1.2mm	» 0.8mm	
<b>Indentation Dimension of Test Tip</b>						
<b>With 300HV</b>	Diameter	0.54mm	0.54mm	0.38mm	1.03mm	0.54mm
	Depth	24 μ m	24 μ m	12 μ m	53 μ m	24 μ m
<b>With 600HV</b>	Diameter	0.54mm	0.54mm	0.32mm	0.90mm	0.54mm
	Depth	17 μ m	17 μ m	8 μ m	41 μ m	17 μ m
<b>With 800HV</b>	Diameter	0.35mm	0.35mm	0.35mm	--	0.35mm
	Depth	10 μ m	10 μ m	7 μ m	--	10 μ m
<b>Impact Device Applicable Scope</b>						
DC	Used for very confined spaces such as holes, cylinders internal measurement					
DL	Used for extremely confined spaces.					
D+15	Used for measuring in grooves, recessed surface.					
C	Used for testing case hardened or thin walled components.					
G	Used for solid heavy component, such as rough castings and forgings.					
E	Used for high hardness material.					

Table 2.1

## 2.5 Standard Configuration

- ◆ LM100 Main Unit
- ◆ D type Impact Device
- ◆ HLD Value Standard Test Block
- ◆ DataView Software
- ◆ USB Communication Cable
- ◆ Small Supporting Ring
- ◆ Cleaning Brush
- ◆ 2 AA Battery
- ◆ Operation Manual
- ◆ Rubber Sheath
- ◆ Instrument Case

## 2.6 Optional Accessories

- ◆ Impact Device: C/G/DC/DL/D+15
- ◆ Standard Test Block
- ◆ Bluetooth Printer
- ◆ Belt
- ◆ Standard Supporting Ring
- ◆ Small Supporting Ring
- ◆ Special Supporting Rings ( See table 2.2 )

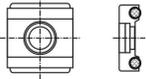
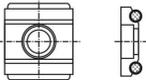
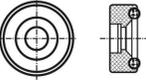
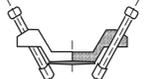
No.	Code	Model	Special Support Ring Sketch	Remark
1	03-03.7	Z10-15		Measure outside the cylindrical surface R10~R15
2	03-03.8	Z14.5-30		Measure outside the cylindrical surface R14.5~R30
3	03-03.9	Z25-50		Measure outside the cylindrical surface R25~R50
4	03-03.10	HZ11-13		Measure inside the cylindrical 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~∞

Table 2.2

### 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 6HLD (HLD=800)

Measuring Direction: Vertically downward, inclined downward, Level, inclined upward, vertically upward

Material : Steel & Cast Steel, Stainless Steel, GC IRON, NC IRON, Cast Aluminum Alloy, Copper-Zinc Alloy, Copper-Tin Alloy, Brass, Forging Steel.

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

Display: High Contrast Segment Liquid Crystal Display (LED Backlight)

Memory: 100 groups ( impact times 1-7 )

Communication Port : USB 2.0 (Standard), and Bluetooth (Optional)

Printer: Thermal Printer with bluetooth (Optional)

Power: 2 AA batteries, 1.5V

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

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

Weight: 280g ( include battery)

Standard: GB/T 17394-2014, ASTM A956

#### 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 of the test piece should not exceed the value in the following table:

Impact Device Type	Workpiece Surface Roughness Ra
D、 DC、 DL 、 D + 15	2 $\mu$ m
G	7 $\mu$ m
C	0.4 $\mu$ m

Table 4.1

#### 4.1.2 Weight and Thickness Requirements

The requirements of different types of impact devices for the quality and thickness of the test piece in the following table:

Impact Device Type	Min weight	Min thickness (no coupling)	Min thickness (coupling)
D、 DC、 DL、 D + 15	0.05~2.0	2.0~5.0	>5.0
G	0.5~5.0	5.0~15.0	>15.0
C	0.02~0.5	0.5~1.5	>1.5

Table 4.2

#### 4.1.3 Surface Hardened Layer Thickness

The requirements of the thickness of the hardened layer on the surface of the test piece in the following table:

Impact Device Type	Min. Thickness of Surface Hardened Layer (mm)
D、 DC、 DL、 D + 15	0.8
C	0.2

Table 4.3

#### 4.1.4 Curved Surface Requirements

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 selected.

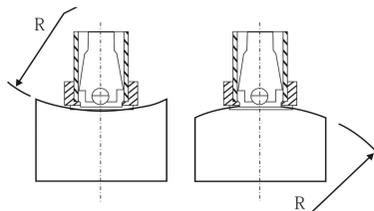


Figure 4.1

## 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

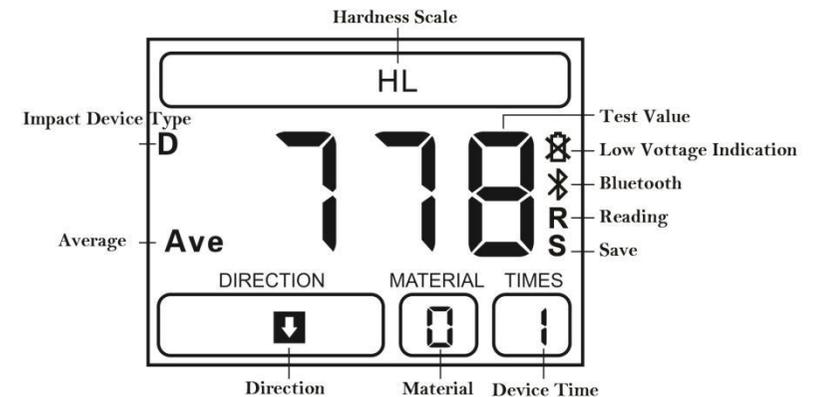


Figure 5.1

## 5.2 Keyboard

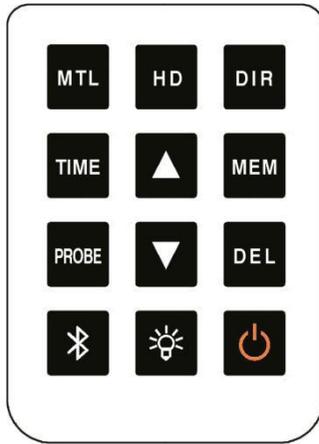


Figure 5.2

### 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 Setting

Press “MTL” button to select the material, material Code No. from 0-9, see the following table:

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	

Table 5.1

#### 5.4.2 Hardness Scale Setting

Press “HD” button to select the hardness scale and strength.

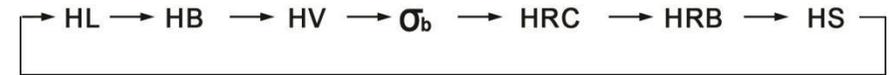


Figure 5.3

#### 5.4.3 Impact Devices

Press “Probe” button to select the probes.

#### 5.4.4 Impact Direction

Press “DIR” button to select impact direction.

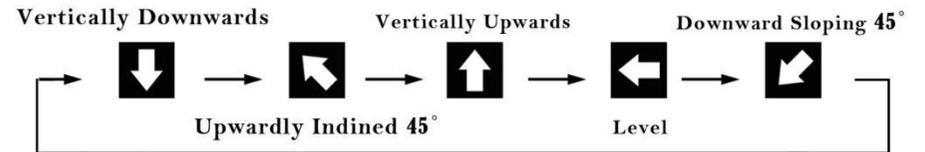


Figure 5.4

#### 5.4.5 Impact Times

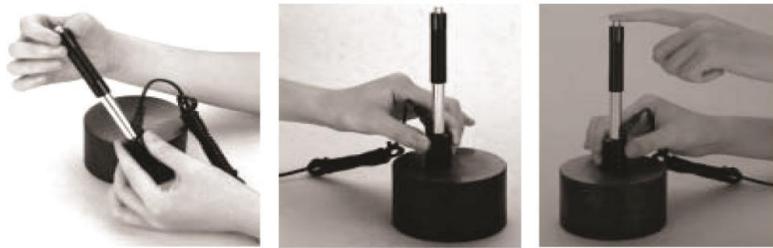
Press “TIME” button to set the impact times from 1-7, which will calculate the average value after the certain times.

## 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. (see Figure 1)
- ◆ Fixed position: Press the impact device support ring firmly on the surface of the sample. (see Figure 2)
- ◆ Release the impact body: 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 impact direction should be vertical to the testing surface. (see Figure 3)



Figur(1)

Figur(2)

Figur(3)

Figure 5.5

◆ After testing, the tester will display as following:

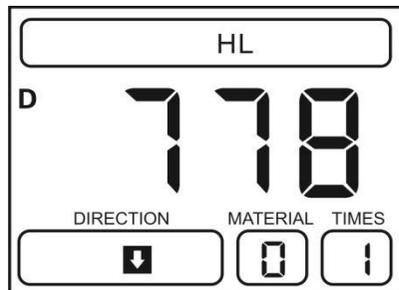


Figure 5.6

### 5.5.2 Delete 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

Normally, the measurements should be the average value of 3-5 times testing results. After setting the impact times, the impact times reach the setting value, will display the average value and the symbol “Ave”. The interface of the average value as following:



Figure 5.7

## 5.7 Data Save and Read Setting

### 5.7.1 Storage Testing Result

Press “MEM” storage button to set the saving function, the “S” symbol will be shown on the display.

The tester will save the testing results automatically, including 7 testing results and 1 average value each group, and total 100 groups can be stored. After storing a group, the storage flag is off.

(Note: During the current group test, before the average value is displayed, press “MEM” storage button to store the group of data)

### 5.7.2 Reading

In saving status, press and hold “MEM” storage button to enter the reading mode and the symbol “R” will be shown on the display (see Figure 5.8). 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” storage button to quit the mode of reading, and the symbol “R” off.



Figure 5.8

### 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 Bluetooth and Print (Optional)

After completing a set of tests and displaying the average value, press the “Bluetooth” button, the Bluetooth symbol  flashes, and the instrument starts to pair the printer automatically. After connecting successfully, the Bluetooth symbol will be shown on the display (see Figure 5.9). The header will be printed automatically, when the printer is successfully connected for the first time, and then the measured value and average value will be printed. When complete a set of tests each time, press the "Bluetooth" button to print this set of values, then the Bluetooth symbol will be off.

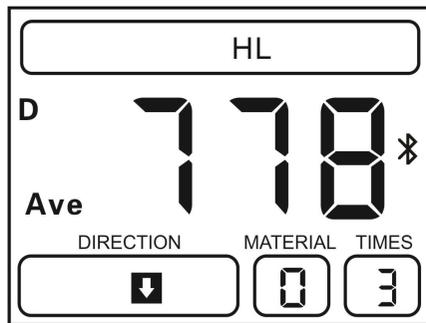


Figure 5.9

## 5.9 Calibration

After a long time of using, the test tip on the impact device will have abrasion, this will cause the measuring error, so we design a calibration procedure of using the standard testing block to calibrate.

Press “up” and “down” button at the same time after the power on, then the tester will enter calibration mode, the identification of calibration  displays. Then impact the standard block with the impact device, measure 1-7 times selectable to get the average value, then press “up” and “down” button to adjust the measured value to the standard value, finally press the “save” button to finish the calibration, the instrument will save the calibrated data and exit the calibration mode. If you want to give up the calibration, please press the “power off” button directly in calibration mode.

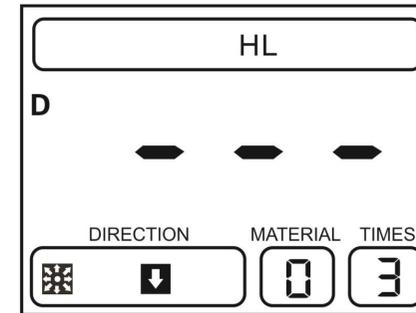


Figure 5.10

## 6. Maintenance & Servicing

### 6.1 Cleaning of Impact Device

After long time using, please use the cleaning brush to clean the tube and impact body.

- ◆ Unscrew the support ring, take out the impact body.
- ◆ Spiral the nylon brush in counter-clock direction into the bottom of the tube and pull it out, repeat many times.
- ◆ Install the impact body and support ring.
- ◆ Release the impact body after testing every times.

### 6.2 Servicing

Leeb hardness tester is a high-tech product, maintenance work should be operated by professionals, please do not operate by yourself.