

# Leeb Hardness Tester User's Manual

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To maximize the benefits of your new tester, please take some time to read these Operating Instructions.

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Table A

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 outside surface R11~R13
5	HZ12.5-17		For testing cylindrical outside surface R12.5~R17
6	HZ16.5-30		For testing cylindrical outside 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 outside surface SR11~SR13
10	HK12.5-17		For testing spherical outside surface SR12.5~SR17
11	HK16.5-30		For testing spherical outside surface SR16.5~SR30
12	UN		For testing cylindrical outside surface, radius adjustable R10~∞

Please note: If the measurement error comes within the range of accuracy specification, please do not make calibration easily.

## 6 Maintenance & 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.

\* When results from repeated testing on a standard hardness test block are consistently higher than the actual hardness value, the Impact Body is probably worn. In such a case, it is necessary to replace an impact body.

## Quick Start Guide

To quickly configure the tester and start taking readings. Please follow the procedures below.

### 1. Preparation for work pieces to be tested

Thick, heavy, and solid workpieces are preferred for testing whenever possible. The surface must be polished and limited to  $Ra \leq 2\mu m$ . The light workpiece to be tested should be fixed to a bearing or support to avoid bending, deformation, and displacement during testing.

### 2. Operation of the tester

#### 2.1 Fit batteries

Install batteries paying careful attention to polarity.

#### 2.2 Power on

Press the **POWER/MENU** key to power the tester on.

#### 2.3 Set Impact Direction by press **DIR/SHIFT** key

#### 2.4 Select a material code See Part 4.3

#### 2.5 Select a hardness scale See part 4.4

#### 2.6 Place the tester onto the surface to be measured

#### 2.7 Load

#### 2.8 Release

### Notes:

1. Never try to let tester strike any tungsten steel or harder materials. Otherwise the impact body will be damaged forever.
2. Under no circumstances should you press the release button if the tester was not against the work piece. Otherwise the support ring would be loose easily.

# 1 Features and Specifications

## 1.1 Typical Applications

- \* Die cavity of molds
- \* Inspection of bearing and other mass produced parts on a production line
- \* Failure analysis of pressure vessel, steam generator and other equipment
- \* Inspection of installed machinery, permanent parts of assembled systems and heavy work pieces.
- \* 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 Testing Features

- \* Palm size for narrow space.
- \* Test at any angle, even upside down.
- \* Direct display of hardness scales HRB, HRC, HV, HB, HS, HL.
- \* Large memory could store 50 groups including single measured value, impact direction, material and hardness scale etc.
- \* User recalibration function allowed.
- \* Can communicate with PC computer for statistics and printing by the optional cable.
- \* Manual or automatic shut down.
- \* Low battery indication.

## 1.3 Technical Specifications

Display: 12.5mm LCD with back light

Accuracy: Display error  $\pm 0.8\%$  at LD=900

Measuring range: 200-900HL

Conversion: HL-HRC-HRB-HB-HV-HSD

Materials: 9 different common materials

With RS232C interface

Memory: 50 data can be stored and re-readable

Impact device: D Will handle the majority of hardness testing applications. Weight: 75g

Power supply: 4x1.5V AAA size battery

Dimension: 146×65×36mm

Weight: 130g (not including batteries)

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

Storage temperature :  $-30^{\circ}\text{C} \sim +60^{\circ}\text{C}$ ;

Relative humidity:  $\leq 90\%$

## 4.7 Data Memorizing

When taking measurements, all values will be stored automatically in memory and the number of stored reading is accordingly increased by 1. The tester can store up to 50 groups of data with measurement conditions. If the memory is full, the tester will auto save the new reading and discard the oldest one. That means the tester only hold the last 50 groups of data in memory.

## 4.8 Memory Recall

Under measuring mode marked by 'M' on the display , press **RD/▲** key to enter into mode of viewing stored values marked by 'R'. Press **RD/▲** key or **DEL/▼** key to recall stored values forwards and backwards. To return to the measurement state, just press the **POWER/MENU** key .

## 4.9 Delete data in memory

In the measurement state marked by 'M' on the display , the new reading can be deleted by pressing **DEL/▼** key , and the number of stored reading is accordingly decreased by 1. To clear memory, just press and hold **DEL/▼** key for 3 seconds till the number of stored reading becomes 000.

## 4.10 Download to PC

This tester can communicate with a PC by optional USB or RS232C cable and software. All the memorized data can download to your PC every time when in a measurement state, you press **RD/▲** key to enter the viewing memorized state.

## 4.11 Auto Power Off

The instrument features an auto power off function designed to conserve battery life. If the tool is idle (neither measuring nor any key operation) for 3 minutes, it will turn itself off.

## 4.12 Battery Replacement

When the battery symbol appears on the display, it is time to replace the batteries. Slide the Battery Cover away from the instrument and remove the batteries. Install batteries paying careful attention to polarity.

## 5. Calibration

After a long period of use, especially for measuring harder materials, the ball tip of impact body will be worn which may lead the tester have more or less error on accuracy. At this moment, this tester is designed to allow recalibration. The calibration can be made in the following way.

5.1 pressing **POWER/MENU** key for 8 seconds into item CAL, and the tester now is in the calibration mode.

5.2 Take measurements on the standard test block.

5.3 Use **RD/▲** key or **DEL/▼** key to adjust the reading on the display to the standard value.

5.4 Repeat 5.2 till the measurement readings are accurate.

5.5 Press **POWER/MENU** key to quit from the calibration mode and return to the measurement mode.

#### 4.6.2 Placement

Holding the tester between your thumb and index finger, hold the tester against the Work piece. Please note: the impact device must be firmly against the surface and the impact direction should be vertical to the testing surface or you may get unsatisfied value.

#### 4.6.3 Releasing

Press the release button lightly on top of the tester and take measurement. The measuring value will be displayed on LCD. To be sure that while releasing the triggering button, the work piece, the impact device and the impact body are all stable and the starting force coincides with the axis of the impact device.

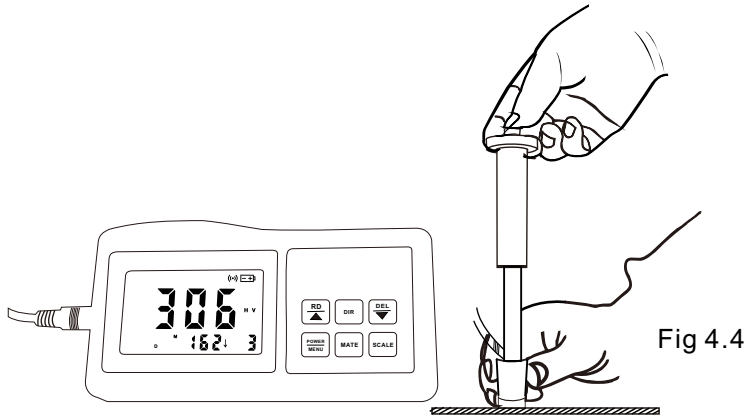


Fig 4.4

If the test results are outside the ranges listed in Table 1.1, the screen will display E.

**Note: Under no circumstances should you press the release button if the tester was not against the work piece. Otherwise the support ring would be loose easily.**

Each measure area of the sample usually needs 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, Just operate as per procedures listed in part 4.4

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

#### 1.4 Measuring and Converting Ranges

Table 1.1

Material	HL	HRC	HRB	HB		HS	HV
				30D <sup>2</sup>	10D <sup>2</sup>		
Steel & Cast St.	300~900	20.0~68.0	38.4~99.5	80~647		32.5~99.5	80~940
C.W. Tool Steel	300~840	20.4~67.1					80~898
ST.STEEL	300~800	19.6~62.4	46.5~101.7	85~655			80~802
Gray Cast Iron	360~650			93~334			
Nodular Cast Iron	400~660			131~387			
Cast Aluminum	174~560				20~159		
Brass	200~550		13.5~95.3	40~173			
Bronze	300~700			60~290			
Copper	200~690			45~315			

#### 1.5 Configuration

Table 1.2

	No.	Item	Quantity	Remarks
Standard Configuration	1	Main unit	1	
	2	Standard test block	1	
	3	Small support ring	1	Included in the main unit
	4	Manual	1	
	5	Carrying case	1	
	6	Cleaning brush	1	
Optional Configuration	1	Other type of impact devices and support rings		
	2	RS232C or USB cable +Software		Refer to Table A in the appendix.
	3	Impact body		

## 2 Structure Feature & Testing Principle

### 2.1 Structure Feature

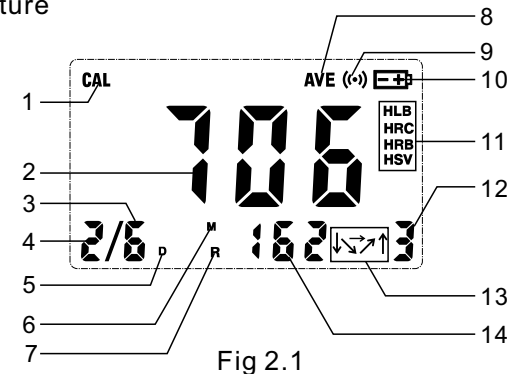


Fig 2.1

- 1 Calibration mode
- 2 Measuring value
- 3 Average times set
- 4 n<sup>th</sup> measuring value
- 5 Impact type
- 6 Measuring state
- 7 Browsing state
- 8 Average Symbol
- 9 Measuring symbol
- 10 Battery indicator
- 11 Hardness scale
- 12 Material
- 13 Direction
- 14 Number of memorized data

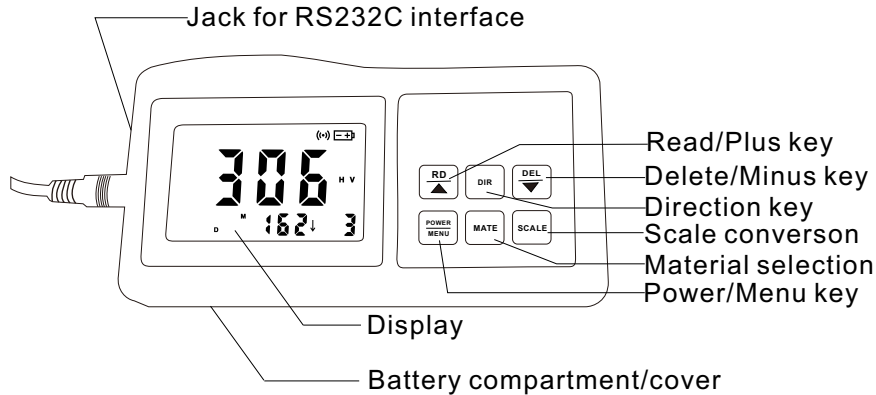


Fig 2.2

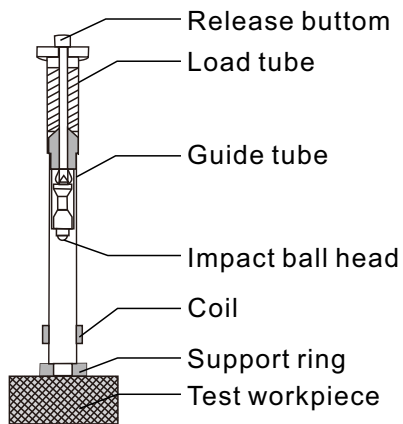


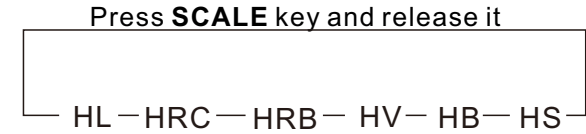
Fig 2.3

#### 4.3 Selecting a material

Press the **MATE** key first and release it. until the desired material is reached.

#### 4.4 Choosing a hardness scale

Press the **SCALE** key first and release it. until the desired hardness scale is reached.



#### 4.5 Average Times Setting

After pressing **POWER/MENU** key for 6 seconds into item AVE, press **RD/▲** key or **DEL/▼** key in turn to select the average times from 2-9, selecting 0 means no mean values. Press **POWER/MENU** key finally to exit from the operation

This function allows you to view the average of the amount of tests you entered.

Example: If you chose "3". The tester will show the average after 3 consecutive tests.

#### 4.6 Measuring Procedure

Use standard test block to check your hardness tester prior to a hardness test.

##### 4.6.1 Loading

Push the Loading Tube towards the support ring to lock the impact body. Then, while still holding on to the loading tube, slowly return it to its original position.

*Caution: Returning the Loading Tube back to its original position too quickly may damage the tester's parts. ALWAYS hold onto the Loading Tube and slowly guide it back in a controlled fashion.*

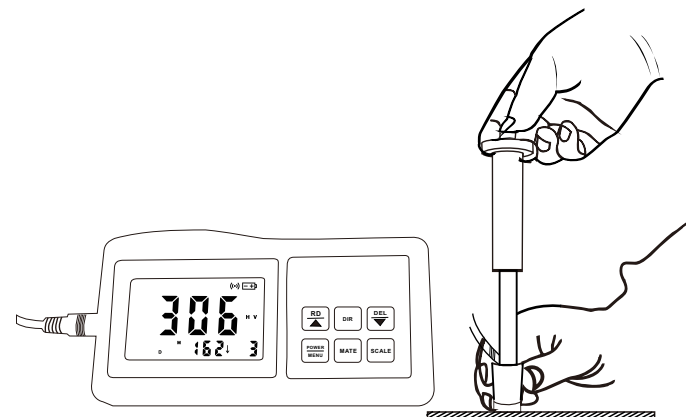
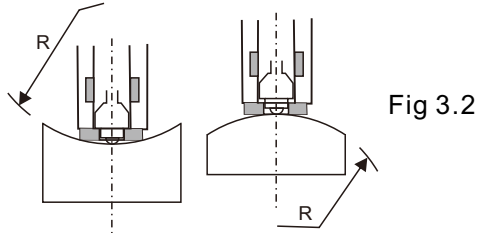


Fig 4.3

### 3.5 Samples with Curved Surfaces

The larger the curvature of the workpiece's surface, the easier the testing operation. Under normal conditions, testing can be done directly with the standard support ring to a curvature with radius of 1 3/16" (30mm) or longer.

For a workpiece with a radius of less than 1 3/16" (30mm), a special support ring should be used for testing.



For impact device type D,  $R_{min} = 30\text{mm}$

### 3.6 Test Sample Properties

Table 3.1

Sample	Sample Weight (kg)			Min. Thickness (mm)		Max. Roughness (or Min. Fineness)			
	Needs Support	Needs to be stabilized	No strengthening needed	Sample	Hardened layer	ISO	Ra	Rz	
D	0.05-2	2.5	>5	3	0.8	N7	2 $\mu\text{m}$	10 $\mu\text{m}$	$\nabla 6$

## 4 Operation of the tester

### 4.1 Power on/off

- \* Press the **POWER/MENU** key, now power is on. The instrument is in working mode.
- \* The LCD will display the same settings that were previously set. If the display meets your current testing requirements, you can start the test immediately. If not, you can enter your required settings using the keypad.
- \* The tester can be turned off by pressing the **POWER/MENU** key for 3 seconds while OFF shows on the display.

### 4.2 Setting your Impact Direction

Use the **DIR** button to move the cursor until you reach the desired direction.

Press **DIR** key and release it

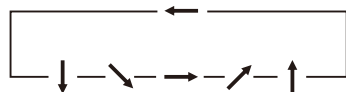


Fig 3.2

### 2.2 Leeb Hardness Testing Principle

An impact body with a spherical test tip made of tungsten carbide is propelled against the sample surface by a spring force and then rebounds back. At a distance of 1mm from the sample surface, the impact and rebound velocity of the impact body are measured by the following method: A permanent magnet embedded in the impact body, when passing through the coil in its coil holder, induces in the coil an electric voltage proportional to the velocities of the magnet. Leeb hardness is expressed by the following formula:

$$HL = 1000 \times (V_B / V_A)$$

Where: HL is Leeb Hardness

$V_B$  is the rebound velocity of the impact body

$V_A$  is the impact velocity of the impact body

The voltage characteristic of output signal, when the impact body passes through the induction coil is illustrated in the following figure:

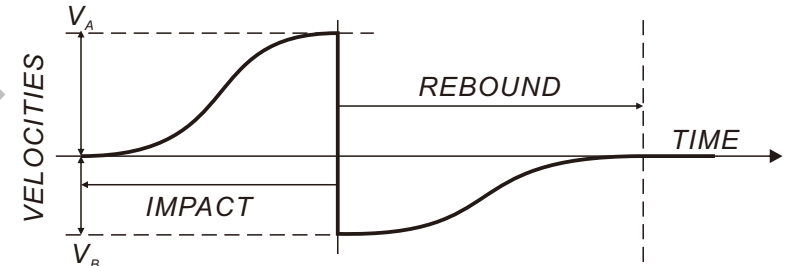


Fig 2.4 Voltage Characteristic of output signal

A Leeb's Hardness Tester measures the hardness of sample material in terms of Hardness Leeb (HL), which can be converted into other Hardness units (Rockwell B and C, Vicker, Brinell and Shore D).

When measuring the hardness of a sample material using the traditional static hardness testing method, a change of applied pressure will result in a change in the hardness reading. This will also happen during a Leeb's Hardness test when you change the impact device. In measuring the hardness of the same test sample with different impact devices, the Leeb's hardness values obtained will vary.

For Example: 760 HLD  $\neq$  760 HLC  $\neq$  760 HLG

### 2.3 Symbols and illustrations of hardness scale

Symbols	Illustrations
LD	Leeb hardness value used with impact device D
HB	Brinell hardness value
HRB	Rockwell B hardness value
HRC	Rockwell C hardness value
HSD	Shore hardness value
HV	Vicker hardness value

## 2.4 Symbols of materials

Symbol	Illustrations
1	Steel and cast steel
2	Cold work tool steel
3	Stainless steel and high temperature-resistant steel
4	Cast iron with lamellar graphite (grey cast iron GG)
5	Cast iron with spheroidal and nodular graphite (GGG)
6	Cast aluminum alloys
7	Copper - zinc alloys (brass)
8	Copper-alu /copper-tin alloys (bronze)
9	Copper

## 3 Preparation

Selection of the workpiece to be tested and preparation of its surface prior to testing will help insure accuracy. Magnetism of the sample itself should be avoided. The surface temperature of sample should be less than 120 °C.

### 3.1 Weight Requirement

To achieve correct test results, select thick, heavy, and solid workpieces for testing whenever possible. The surface area where the impact body strikes should have an even hardness.

A solid workpiece that weighs more than 11lbs. (5Kg) can be tested on directly with the this hardness testers. Support is not necessary for heavy sample.

A workpiece that weighs 6 to 11lbs. (3 to 5Kg) should be fixed to a bearing or support weighing over 11lbs (5kg) to avoid bending, deformation, and displacement during testing.

A workpiece that weighs less than 4 lbs. (2Kg) should be secured to a workbench or a stable support. The surface between the workpiece and the support must be hard, clean, and smooth. To secure the workpiece, apply petroleum jelly or yellow grease to the adjoining surfaces of the workpiece and support, press the workpiece firmly onto the support, and eliminate any air between the two surfaces by moving the workpiece back and forth.

Proper coupling requires a little experience. Insufficiently coupled samples produce large variations of individual measurements, HL-values which are too low and the operation is characterized by a rattling noise upon impact of the test tip.

For the coupling operation, the following prerequisites must be fulfilled:

- \* The contact surface of the sample and the surface of the base plate must be flat, plane parallel and ground.
- \* The direction of the test impact must be perpendicular to the coupled

surface.

- \* Minimum thickness of the sample for coupling (3mm).

### 3.2 Roughness Requirement

To eliminate measurement errors which could result from the roughness of the test surface, the surface should be polished so that a metallic luster appears. The roughness (Ra) of the surface must be limited to  $\leq 2\mu\text{m}$ . Note that the rougher the surface of the workpiece, the lower the hardness test results.

### 3.3 Cleanliness Requirements

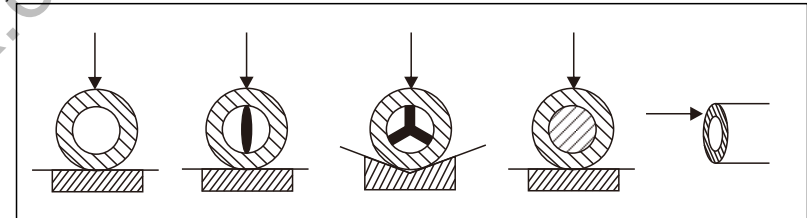
To ensure test accuracy, the test surface of the workpiece must be clean and free of any oil stains, rust, and remains from electro-plating or paint.

### 3.4 Stability Requirements

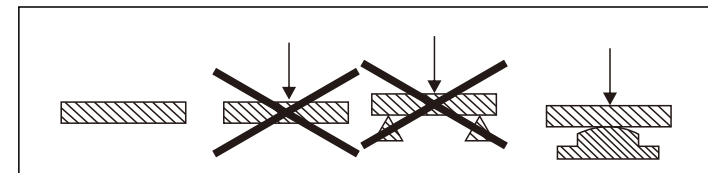
To avoid displacement during testing, the workpiece should be firmly fixed with its test surface perpendicular to the impact direction. Due to the impact of the Impact Body, the test area may deform or vibrate, even for some workpieces with suitable weight and thickness.

The tested hardness may be lower than normal. This is especially true for workpieces such as a large plate, a long bar or a rod, and workpieces with a curved surface. Some testing recommendations for these workpieces are shown in figure 3.1

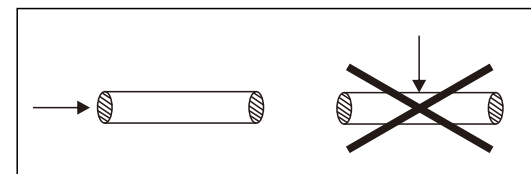
#### (1) PIPE



#### (2) PLATE



#### (3) ROD or LONG BAR



Note:

✗ This indicates an improper test.

Otherwise, test method is accurate.

Fig 3.1