TCM-R1

Leeb Hardness Tester

User Manual

Preface

Hello:

Thank you for your purchase of our Leeb Hardness Tester TCM-R1Series (it is called Hardness Tester below), the Hardness Tester is portable device. It is small in size, light in weight and very easy and fast to take a test. Before using the Hardness Tester you must read this User's Manual carefully.

The Hardness Tester confirms to the following specifications:

Technical standards for Leeb Hardness Tester, JB/T 9378-2001

Transformation relation of different hardness scales, ISO 18265: 2003

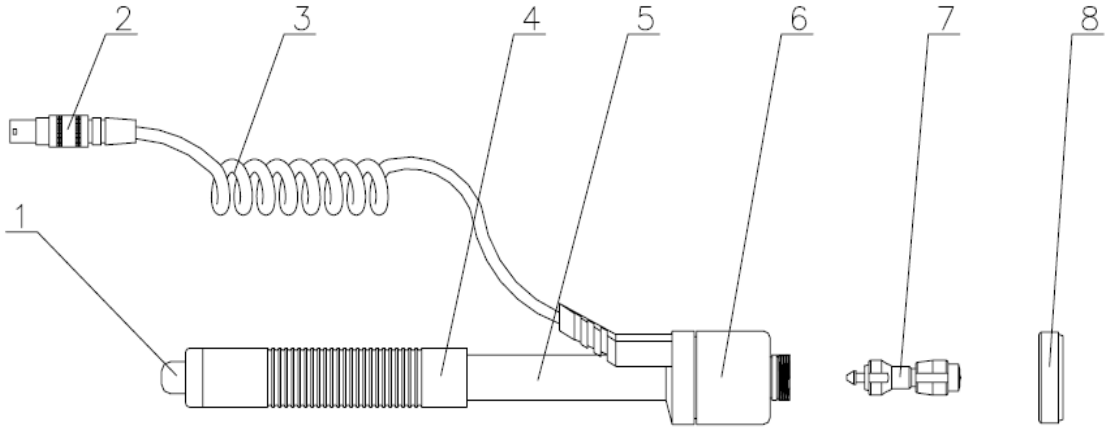
CONTENTS

1 Structure Feature

1.1The body

Front view

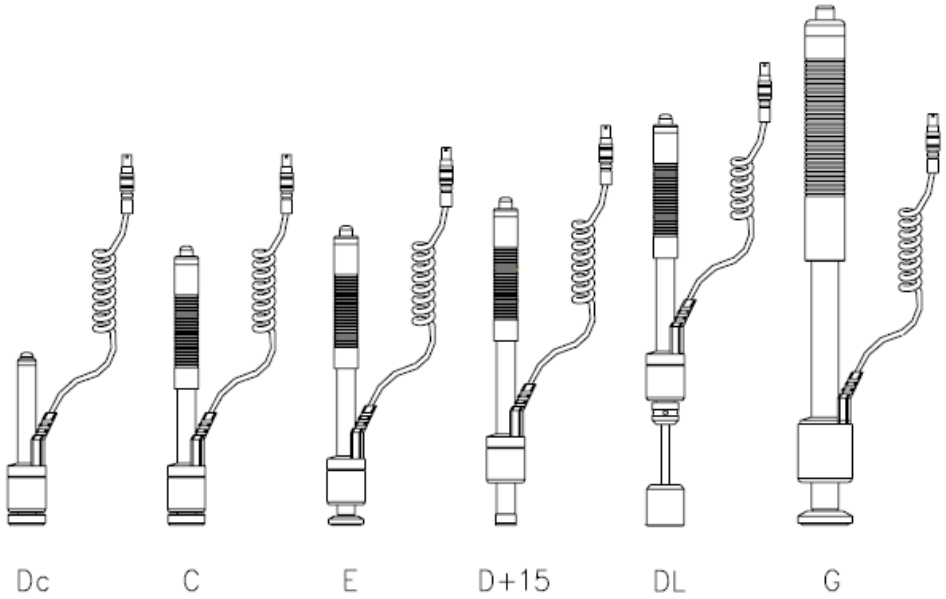
1.2 Impact device of type D



1. Release button 2.Plug of the impact device 3.Connection cable 4.Loading tube 5.Guide tube 6.Coil unit 7. Impact body 8.Support

ring

1.3 Some other types of impact device available as options



1.4 Technical Specifications

Error and repeatability of displayed value see Table 1.

Table 1

Type of impact device	DC(D)/DL	D+15	C	G	E

Impacting energy Mass of impact body	11mJ 5.5g/7.2g	11mJ 7.8g	2.7mJ 3.0g	90mJ 20.0g	11mJ 5.5g
Test tip hardness: Dia. Test tip: Material of test tip:	1600HV 3mm Tungsten carbide	1600HV 3mm Tungsten carbide	1600HV 3mm Tungsten carbide	1600HV 5mm Tungsten carbide	5000HV 3mm synthetic diamond
Impact device diameter: Impact device length: Impact device weight:	20mm 75mm 50g	20mm 162mm 80g	20mm 141mm 75g	30mm 254mm 250g	20mm 155mm 80g
Max. hardness of sample	940HV	940HV	1000HV	650HB	1200HV
Mean roughness value of sample surface Ra:	1.6μm	1.6μm	0.4μm	6.3μm	1.6μm
Min. weight of sample: Measure directly Need support firmly Need coupling tightly	 >5kg 2～5kg 0.05～2kg	 >5kg 2～5kg 0.05～2kg	 >1.5kg 0.5～1.5kg 0.02～0.5kg	 >15kg 5～15kg 0.5～5kg	 >5kg 2～5kg 0.05～2kg
Min. thickness of sample					

Coupling tightly Min. layer thickness for surface hardening		5mm ≥0.8mm	5mm ≥0.8mm	1mm ≥0.2mm	10mm ≥1.2mm	5mm ≥0.8mm
Size of tip indentation						
Hardness 300HV	Indentation diameter Depth of indentation	0.54mm 24µm	0.54mm 24µm	0.38mm 12µm	1.03mm 53µm	0.54mm 24µm
Hardness 600HV	Indentation diameter Depth of indentation	0.54mm 17µm	0.54mm 17µm	0.32mm 8µm	0.90mm 41µm	0.54mm 17µm
Hardness 800HV	Indentation diameter Depth of indentation	0.35mm 10µm	0.35mm 10µm	0.35mm 7µm	-- --	0.35mm 10µm
		DC: Test hole			**G:** Test	**E:** Test

Available type of impact device	or hollow cylindrical; DL: Test slender narrow groove or hole	**D**+15: Test groove or slot surface	**C**: Test small, light, thin parts and surface of hardened layer	large, thick, heavy and rough surface steel	super high hardness material

2 Overview

2.1 Features

- Ultra-thin case, making it extremely portable and easy to hold
- Suitable for multiple impact devices and 6 types of hardness scales are available for various applications
- Large and clear digital display
- Ultra-low power dissipation with three AAA batteries powered

2.2 Technical Specification：

- **Hardness Scales**：HL、 HRC、HRB、HV、HB、HS
- **Test** Precision：HLD：±6 HRC：±1 HB：±4
- **Standard Impact Device:** impact device of Type D
- **Upper / Lower Limits Setting**：(170-960)HLD, (17.9-69.5)HRC, (19-683)HB, (80-1042)HV, (30.6-102.6)HS, (13.5-101.7)HRB
- **Optional Impact Device:** D/ C /DC / D+15 / DL/ G
- **Number of Impact Devices Equipped With One Time:** one

- **Language**： Chinese/English
- **Screen Display:** 128X64 dot matrix LCD, backlight and adjustable contrast
- **Measuring Direction**：360°（down, inclined down, level,inclined up and up）
- **Data Memory** ：200 readings
- **Maximum Hardness of The Measured Work Piece:** 940HV（for D,DC,DL,D+15,C impact device）
- **Radius of Rurvature of The Measured Work:** Rmin=50mm（If using Alien supporting ring, Rmin=10mm）
- **Recognition Function**：Recognize the type of the impact device by itself
- **Measurable Material**：Steel and cast steel, alloy tool steel, stainless steel, gray cast iron, nodular cast iron, aluminum casting alloy, copper zinc alloy(brass), copper tin alloy(bronze), fine copper
- **Power Supply:** 1.5V AAA battery (3 PCS)
- **Working time:** about 150 hours
- **Shape Size:** 155mm*68mm*27mm
- **Weight:** 230g

2.3 Main function parameter

- Choose Testing Materials, Hardness Scales, Measuring Direction and times of Tests By Button;
- Direct Display of Hardness Scales including HRB, HRC,HV, HB, HS, HL;
- Show the Result of Each Test Repeated, Automatically or Manually Remove the Wrong Test Results;
- Directly Output the Average Single Test Result or All the Results In One Time;
- Automatic detection of the Battery Voltage, Low Voltage Warning for Battery protection, with Battery Indicating Icon in Test Status;
- Descriptivef Status Bar Display, Buzzer, Error Information, Time, Battery Quantity and so on;
- Ambient temperature：Operating temperature－10～＋50°C;

- Storage temperature：-30℃～＋60℃.

2.4 Testing and measurement range

Table 2 Measurement range

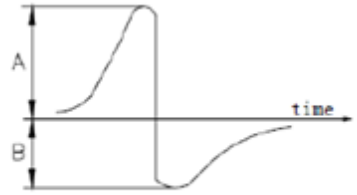
Material	Method	Impact device					
		D/DC	D+15	C	G	E	DL
Steel and cast steel	HRC	17.9～68.5	19.3～67.9	20.0～69.5		22.4～70.7	20.6～68.2
	HRB	59.6～99.6			47.7～99.9		37.0～99.9
	HRA	59.1～85.8				61.7～88.0	
	HB	127～651	80～638	80～683	90～646	83～663	81～646
	HV	83～976	80～937	80～996		84～1042	80～950
	HS	32.2～99.5	33.3～99.3	31.8～102.1		35.8～102.6	30.6～96.8
Steel	HB	143～650					
CWT、ST	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					
GC. IRON	HRC						
	HB	93～334			92～326		
	HV						
NC、IRON	HRC						
	HB	131～387			127～364		
	HV						
C．ALUM	HB	19～164		23～210	32～168		
	HRB	23.8～84.6		22.7～85.0	23.8～85.5		
BRASS	HB	40～173					
	HRB	13.5～					

	95.3						
BRONZE	HB	60～290					
COPPER	HB	45～315					

2.5 Leeb Hardness Testing Principle

The basic principle is: 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.



Output signal of impact device

The calculation formula is as follows:

HL=1000×VB/ VA

Where, HL—— Leeb hardness value

VB—— Rebounding velocity of the impact body

VA—— Impacting velocity of the impact body

3 Preparation & Testing

3.1 Preparation & Inspection before Testing

3.1.1Preparation of Sample Surface

Preparation for sample surface should conform to the relative requirement in the Table 3.

(1) In the preparation processing for sample surface, the hardness effect of being heated or cold processing on the surface of sample should be avoided.

(2)Surface roughness of the measured surface outside the recommended range will cause measurement error. So the surface of the sample to be measured must have the appearance of a metallic luster, smooth, free of scale, paint, rust, etc.

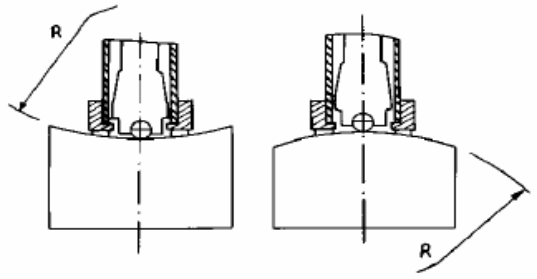
(3)Support of test sample. Support is not necessary for heavy sample of greater than 10lbs. Medium weight parts must be set on flat and stable solid surface e.g. steel table NOT wood. The sample must set absolutely stable on the surface without any wobble or spring.

(4)The sample should have enough thickness, and minimum thickness of sample should conform to Table 3.

(5)For the sample with hardened layer on surface, the depth of hardened layer should conform to Table 3.

(6)Curved surface: The best testing surface of sample is flat. When the curvature

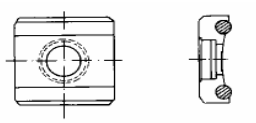
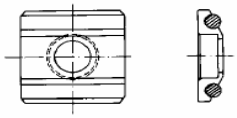
radius R of the surface to be tested is smaller than 30mm (D, DC, D+15,C, E and DL type of impact device) and smaller than 50mm (G type of impact device), the small support ring or the shaped support rings should be chosen.

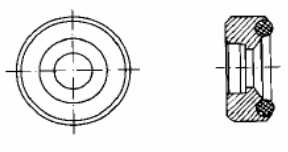
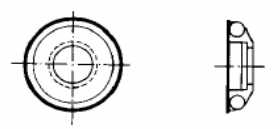
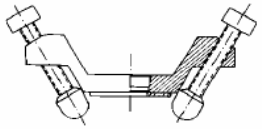


(7) Coupling. Light-weight sample must be firmly coupled with a heavy base plate. Both coupled surface must be flat and smooth, and there is no redundant coupling agent existing. The impact direction must be vertical to the coupled surface. When the sample is a big plate, long rod or bending piece, it 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.

(8)Magnetism of the sample itself should be avoided.

Table 3

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 ~ ∞

3.1.2 System Setting

See 4.5 for details.

3.1.3 Presetting Testing condition

See 4.2 for details.

3.2 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 table 4.

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.

3.2.1 Start-Up

(1)Insert the plug of the impact device into the socket of impact device on the tester.

(2)Press  key，now power is connected. The instrument is in testing condition.

Table 4:

No.	Material	HLD	Strength σ_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

3.2.2 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.

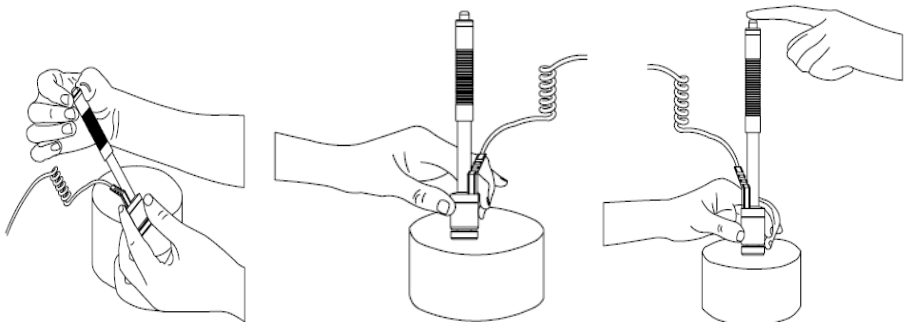


Chart 1 Chart 2 Chart 3

3.2.3 Localization

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

3.2.4 Testing

(1)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.

(2)Each measure area of the sample usually need 5 times of testing operation. The result data dispersion should not more than mean value±15HL.

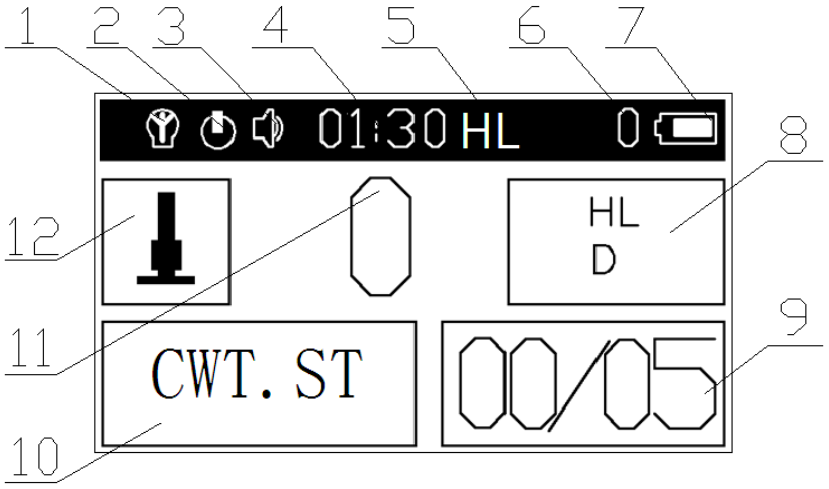
(3)The distance between any two impact points or from the center of any impact point to the edge of testing sample should conform to the regulation of Table 5.

Table 5

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

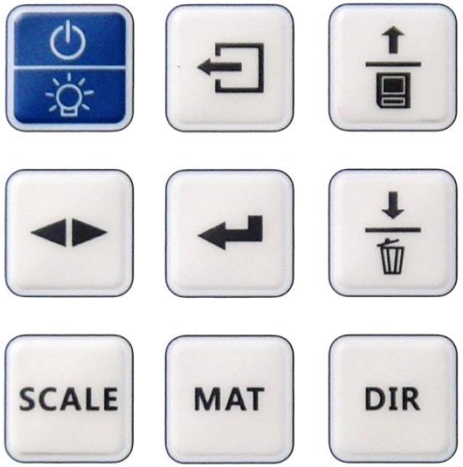
(4)If you want accurate conversion from the Leeb hardness value to other hardness value, contrastive test is needed to get conversion relations for the special material. Use inspection qualified Leeb hardness tester and corresponding hardness tester to test at the same sample respectively. For each hardness 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.

4 Operation in Details



1.LCD Backlight 2. Standby time 3.Silent mode 4.Time display 5. Sign of HL

6. Measure value by HL 7. Battery status 8. Hardness Scale 9.Times 10.Material 11. Measure value 12. Impact direction



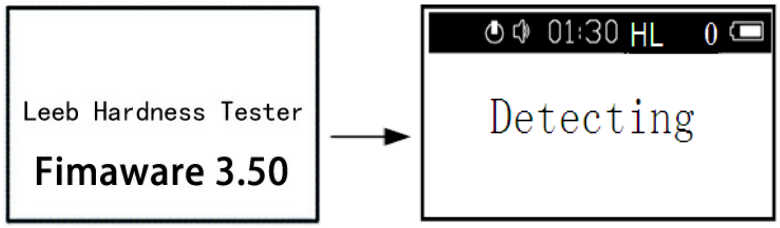
Diagrams of the keyboard

Function of the keys:

- Power on/off and LCD brightness on/off.
- Menu/Enter
- Cancel or Escape.
- DIR Direction.
- MAT Material.
- SCALE Scale.
- Upward/Save
- Downward/Delete
- Left/Right.

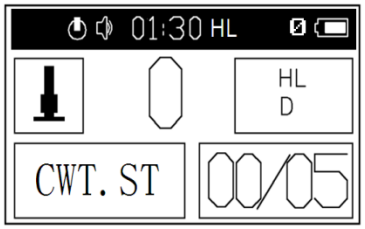
4.1 Power on

Plug in the impact device, and press to power on the system. The screen shows as below:



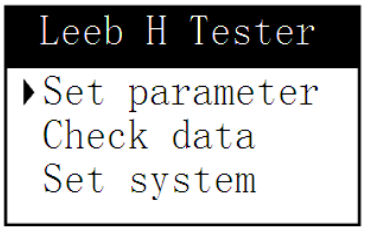
The system would automatically detect the type of the impact device during power up and would display this information on the screen as below.

Following is the main display interface as below.

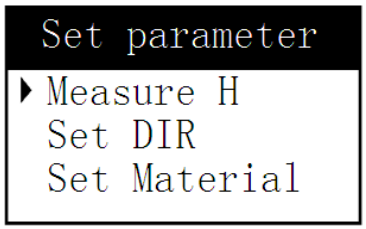


4.2 Test Set

Press at the main interface to enter the main menu—Leeb H Tester, as below. Press key or could continuously glance downward or upward.



Press to enter menu "Set parameter". Press key or to move the cursor to the line you want to set, and press key to enter submenu.



4.2.1 Hard/σ setting

Press key or to move the cursor to the line of "Measure H", and then press key to switch **H/TS** continuously.

Note:

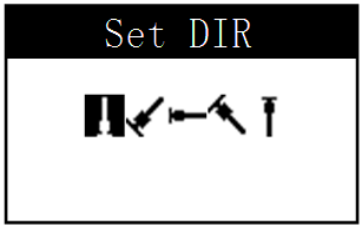
1. H is short for Hardness and TS is short for strength.

2. When H/TS is switched to TS, the hardness scale could not be selected.

3. Only D type of impact device has the function of TS measure. So the impact device could not be selected.

4.2.2 Impact Direction Setting

Press key or to move the cursor to the line of "Set DIR", and press key to enter submenu "Set DIR ", and then press key or to choose one of the five kinds of impact direction such as downward, upward, downward 45°, upward 45° and level180° as below. After setting up correctly, press key to to confirm it and return submenu "Set parameter".



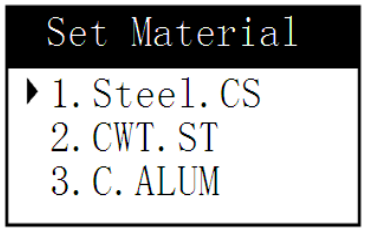
Set impact direction using shortcut key:

Press key DIR in main interface to change times quickly.

4.2.3 Material Setting

When **H/TS** 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. And when **H/TS** 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.

Enter submenu"Set Material", and then press key or to move the cursor to the material you want to preset. Press key to confirm it and return submenu"Set parameter" as below.



Set material using shortcut key:

Press key MAT in main interface to change times quickly.

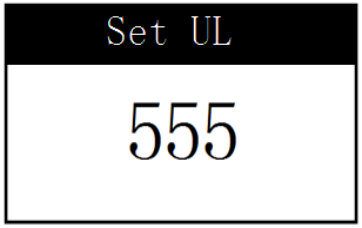
4.2.4 Average Times Setting

Enter submenu"Set Times", and then press key ↓ or ↑ to set the times you want to preset as below.

Press key ↵ to confirm it and return submenu" Set parameter ".

4.2.5 Tolerance Limit Setting

Enter sub-menu"Set UL", and then press key ◄► to move the cursor and press key ↓ or ↑ to change the number as below.



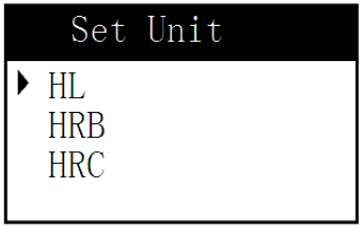
Press key to confirm it and return sub-menu "Set parameter".

NOTE:1. UL is short for up limit and LL is short for lower limit.

2. Set LL is the same with UL.

4.2.6 Hardness Scale Setting

Enter submenu "Set Unit", and then press key or to move the cursor to the hardness scale you want to preset, as below.



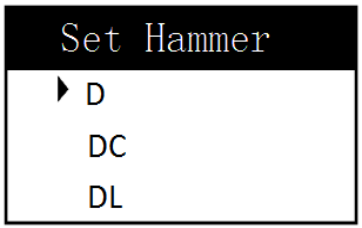
Press key to confirm it and return submenu" Set parameter ".

Set hardness scale using shortcut key:

Press key SCALE in main interface to change hardness scale quickly.

4.2.7 Impact device setting

Enter submenu"Set Hammer", and then press key or to move the cursor to the impact device you want to preset, as below.



Press key to confirm it and return submenu "Set parameter".

NOTICE: When the "AVE" mark is displayed on the screen, it is invalid to use shortcut key to change parameters. At this time, saving the old result in order to start a new setup is necessary.

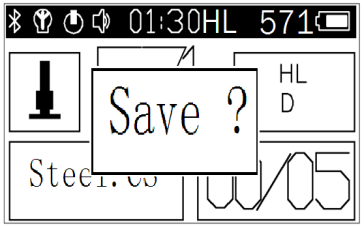
4.3 Testing

See chapter 3 for details

4.4 Save and Print the data

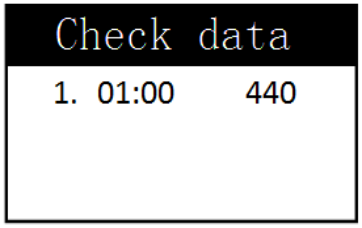
4.4.1 Save the data

After finishing the test, press key to save the data, then press key to confirm it or press key to cancel it.

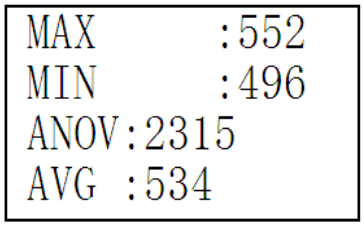


4.4.2 Check the data

Press key to return to the main menu "Leeb H Tester". Now press key or to move the cursor to the line of "Check data", and then press key to enter submenu " Check data" where you can check the data we have saved as below.



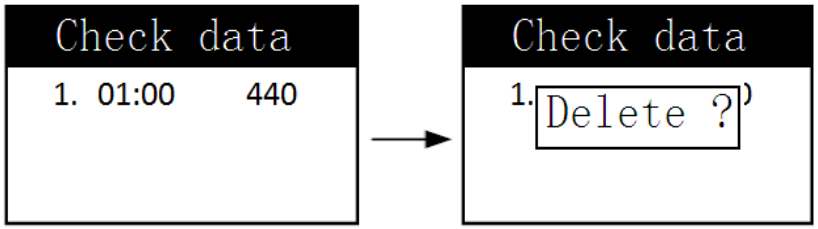
Press or to move the cursor to the line which you want to see details, the press key to check the detail information of the data as below.



Press the key ◀▶ to turn the page to check all of the information.

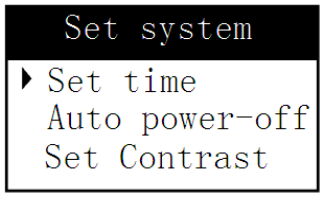
4.4.3 Delete the data

Enter submenu" Check data", and press key ↓ to delete the data, then press key ↵ to confirm it or press key ⏎ to cancel it as below.



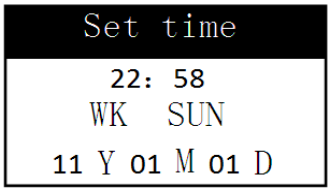
4.5 System set

Press the key ⏎ to return to the main menu "Leeb H Tester". Now press key ↓ or ↑ to move the cursor to the line of "Set system", and then press key ↵ to enter submenu" Set system" as below.



4.5.1 Time data set

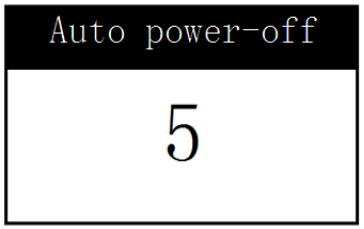
Press key ↓ or ↑ to move the cursor to the line of "Set time", and press key ↵ to enter submenu" Set time" as below.



Press key ◀▶ to move the cursor and press key ↓ or ↑ to change the NO. Press key ↵ to confirm it and return submenu" Set system ".

4.5.2 Auto power-off

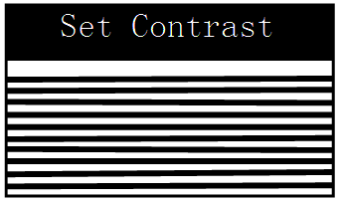
Press key ↓ or ↑ to move the cursor to the line of "Auto power-off", and press key ↵ to enter submenu" Auto power-off" as below.



Press key ↓ or ↑ to change the standby time. For example, the digital 1 indicates the standby time is 1 second and the maximum standby time is 10 seconds, while NO.0 indicates standby time is infinite. The Sign ⏻ shows in the screen when the number is not 0. Press key ↵ to confirm it and return submenu"Set system".

4.5.3 LCD brightness set

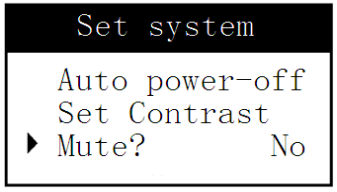
Press key ↓ or ↑ to move the cursor to the line of "Set Contrast", and press key ↵ to enter submenu" Set Contrast" as below.



Press key or to change the LCD brightness. Press key to confirm it and return submenu "Set system".

4.5.4 Silent mode set

Press key or to move the cursor to the line of "Mute? No" and then press key to switch on/off the silent mode continuously as below.



If the silent mode is off, the sign in the screen is or it is .

5 Servicing & Maintenance

5.1 Impact Device Servicing

1) 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 5-6 times, and then install the impact body and support ring again.

2) Release the impact body after use.

3) Any lubricant is absolutely prohibited inside the impact device.

5.2 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.

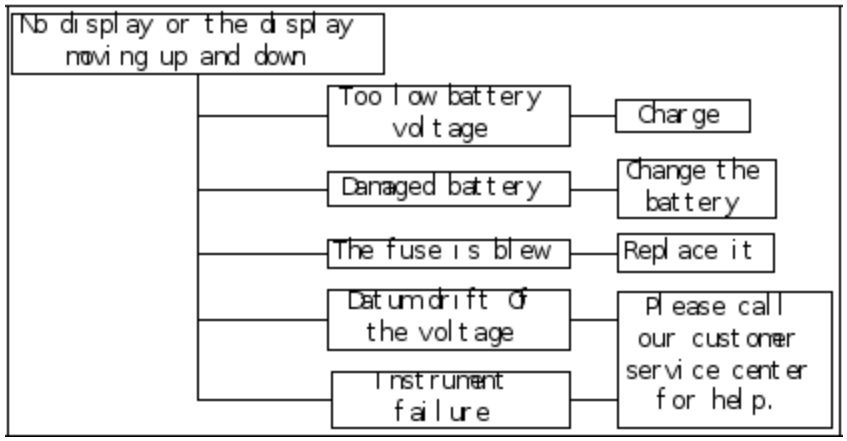
When the hardness tester appears some other abnormal phenomena, please do not dismantle or adjust any fixedly assembled parts. Fill in and present the warranty card to us. The warranty service can be carried on.

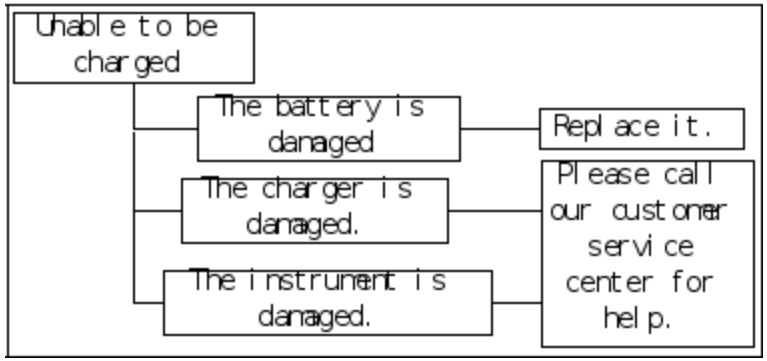
5.3 The battery

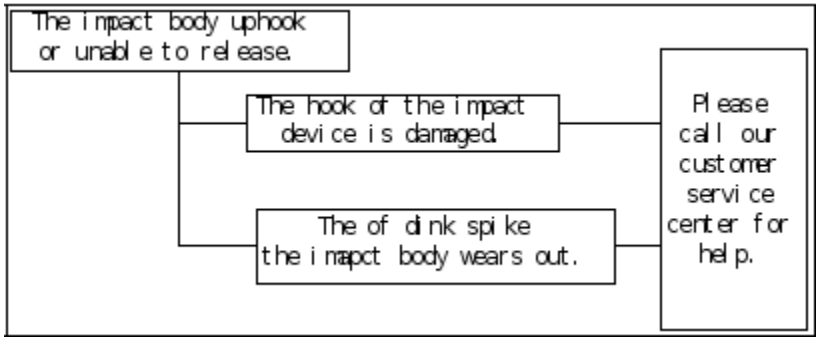
1) Press  to power off the system， and open up the back cover to take out the battery.

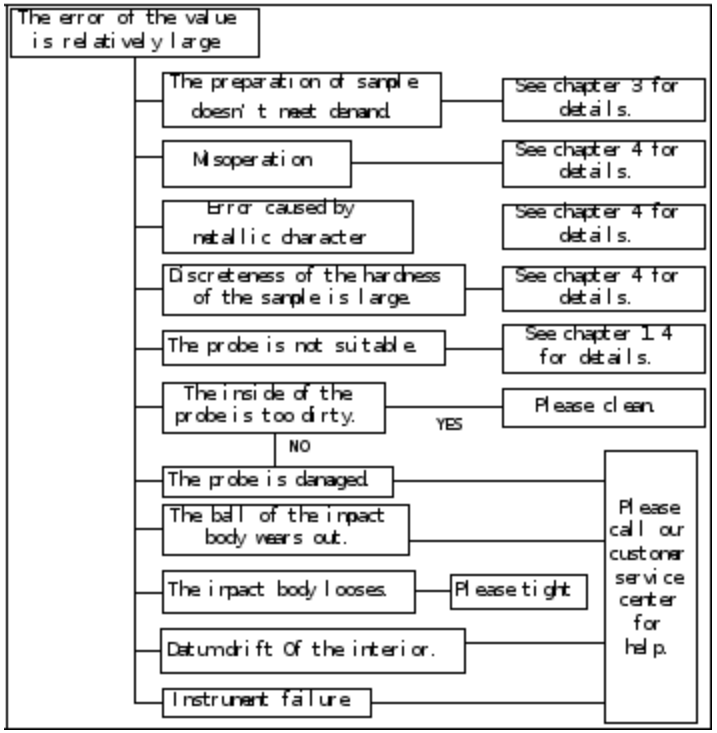
2) Remove the battery when not using the instrument for long time, in order to avoid battery leakage and corrosion the instrument.

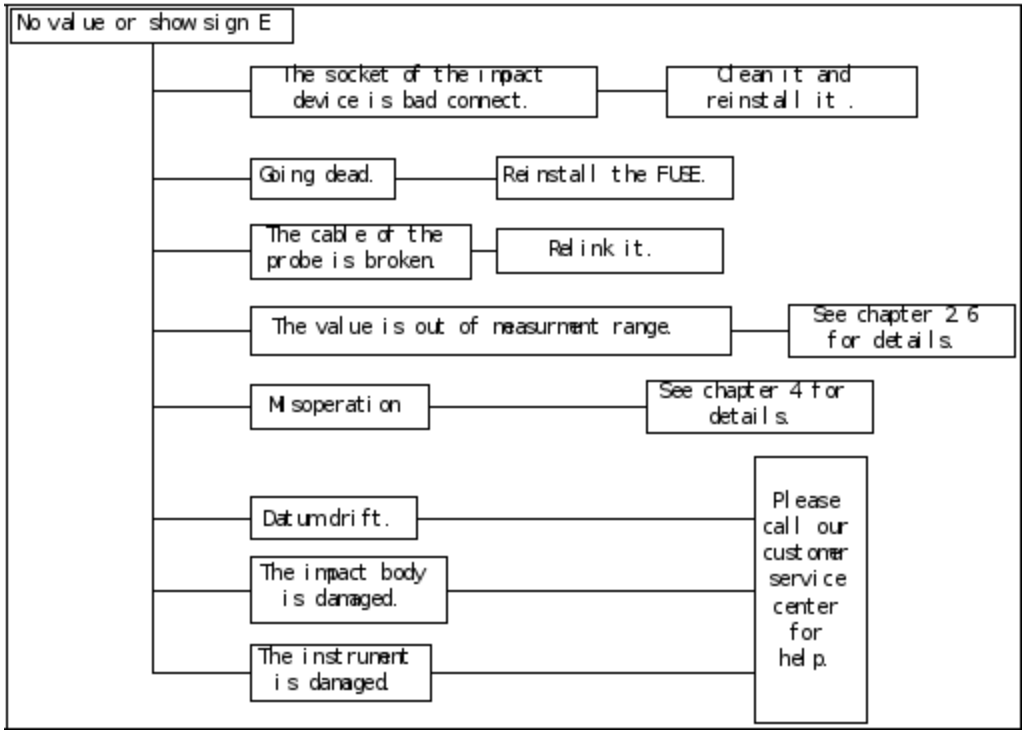
6 Malfunction analysis and maintenance

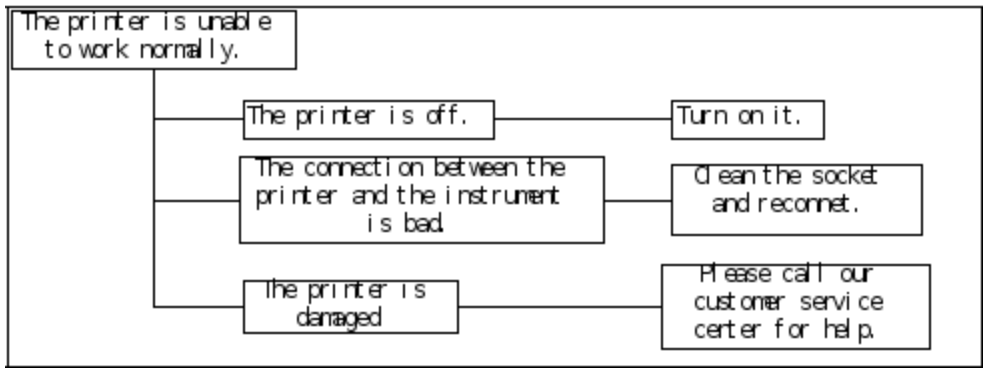



Unable to be charged
The battery is damaged
Replace it.
The charger is damaged.
Please call our customer service center for help.
The instrument is damaged.


The impact body uphook or unable to release.
The hook of the impact device is damaged.
Please call our customer service center for help.
The of clink spike the imapct body wears out.


The error of the value is relatively large
The preparation of sample doesn't meet demand.
See chapter 3 for details.
Misoperation
See chapter 4 for details.
Error caused by metallic character
See chapter 4 for details.
Discreteness of the hardness of the sample is large.
See chapter 4 for details.
The probe is not suitable.
See chapter 1.4 for details.
The inside of the probe is too dirty.
YES
Please clean.
NO
The probe is damaged.
The ball of the impact body wears out.
The impact body looses.
Please tight.
Datum drift Of the interior.
Instrument failure
Please call our customer service center for help.


No value or show sign E
The socket of the impact device is bad connect.
Clean it and reinstall it .
Going dead.
Reinstall the FUSE.
The cable of the probe is broken.
Relink it.
The value is out of measurment range.
See chapter 2.6 for details.
Misoperation
See chapter 4 for details.
Datum drift.
The impact body is damaged.
The instrument is damaged.
Please call our customer service center for help.


The printer is unable to work normally.
The printer is off.
Turn on it.
The connection between the printer and the instrument is bad.
Clean the socket and reconnet.
The printer is damaged.
Please call our customer service certer for help.

<1> When using standard Rockwell hardness block to testing, if all the error is bigger than 2HRC, it may be the invalidation of impacted ball top caused by abrasion. Changing the spherical test tip or impact object should be considered.

<2>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.

7 List of components not warranty

1 the shell 2 the screen display 3 the panel 4 the impact body 5 the support ring 6 the probe cable 7 the battery(the damage caused by faulty operation problem)

8 Instructions for Standard Leeb Hardness Test Specimen

The Standard Leeb Hardness Test Specimen is a new standard instrument of measurement for hardness measurement used for periodic calibration or daily calibration for the Leeb Tester and the standard have delivered the Leeb Hardness magnitude Since April 1, 2004. We'll give a brief description of the standard to make you know and use it correctly. The rule for the error of indication and the repeatability of indication of the Leeb Hardness value is listed in table 7, the rule made by the national metrological verification regulations (JJG747-1999) in table 7 is suitable for Leeb Hardness Tester of new, in use and having been repaired.

Error of displayed value: **δ= HLD-HLD**

In the formula, HLD represents for the average of five measurement values, HLD represents for the hardness value of Standard Leeb Hardness Test Specimen.

Repeatability of displayed value: **b= HLDmax-HLDmin**

In the formula, HLDmax represents for the maximum value of the five measurement values, HLDmin represents for the minimum value of the five measurement values. The HLD in the two formulas above can also be HLDC,HL(D+15),HLC,HLG and HLE.

Table7: Error and repeatability of displayed value

NO.	Type of impact device	Hardness value of Leeb standard hardness block	Error of displayed value	Repeatability of displayed value
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 HLDC 10 HLDC
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

Users Notice

1. Please fill out the warranty registration card completely. Then mail the copies of the warranty registration card and the invoice within 15 days of receipt of the product to our user service center.

2. If there is a fault or problem within a year after you the instrument please contact us. When you receive an RMA # return the instrument to us with a copy of your warranty registration card and invoice. If you can't show the warranty registration card and the invoice we would calculate the warranty period from the date the instruments was manufactured, and the warranty period is one year.

3. If it is out of the warranty period, we will assess and repair costs up return of the product to us .

5. Damages caused by transportation, installation, faulty operation, non-professional maintenance are out of warranty service. If you alter the warranty registration car or there is no invoice, the warranty is voided.

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