INSTRUCTION MANUAL

HARDNESS TESTER DHT- 200$_{Plus}$



V1.0.0

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1. Summary

DHT-200Plus Leeb hardness tester, based on the principle of Leeb theory, can be used for hardness testing of various metals. With the feature of compact size, it is suitable for working on various circumstances. The Leeb hardness values can be easily converted to HRC, HRB, HV, HS and so on. In order to operate the instrument correctly and properly, users are required to read this instruction manual completely before using it.

2. Principle of Leeb hardness testing method

2.1 History of Leeb hardness testing method

The Leeb hardness testing method was first introduced by Dr. Leeb in 1978. It is defined as the quotient of an impact body's rebound velocity over its impact velocity, multiplied by 1000. Hard materials produce a higher rebound velocity than that of softer materials. For a specific group of material (e.g. steel, aluminum. etc.), Leeb hardness value represents a direct relationship to its hardness properties. For ordinary metal, conversion curves of hardness HL versus other standard static hardness (HB, HV, HRC, etc.) are available, enabling you to convert HL into other hardness values.

2.2 Definition of Leeb hardness

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. The Leeb hardness values are expressed by the following formula:

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

Where:HL is Leeb hardness values

V_b is the rebound velocity of the impact body

V_a is the impact velocity of the impact body

Figure 1 show the voltage produced during the impact and rebound of impact body.

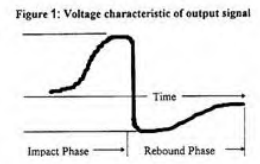


Figure 1 Voltage features of output signal

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

2.3 Available Functions

- ●320×240 matrix TFT Color LCD
- ●Auto connects to 32 bits / 64 bits computer system.
- ●100 files x 100 data can be stored.
- ●Auto identification of impact device D, DC, DL, D+15, C, G
- ●Quick entry of test numbers, test data, sample material type and impact direction via the keypad.
- ●Deletion of erroneous or incorrect previously stored test data.
- ●Display of the current test mode and its corresponding test data.
- ●Quick print out of all test results via inner mini-printer.
- ●Auto converse to hardness value (*HL, HRC, HRB,HB, HV, HSD)*
- ●Low Battery Indicator

2.4 Symbol of Leeb's hardness values

Just like the other hardness scales, users will get different hardness values with different impact devices, for example:
720HLD≠720HLC.
Owing to different converting curves obtained from different hardness scale, when converting from hardness scale L to another hardness scale, the notation for the converted hardness value should include the impact device used. For example: the Leeb hardness value 510HLD should be expressed as below when it is converted to Rockwell hardness scales HRC: 510, 20 HRCLD in which：

510 Leeb hardness values
20 converted hardness values
HRC means the converted object
L means the measuring method
D means D impact device

3. Pre-treatment of work piece

To get the accurate measuring results, pre-treatment of work piece is required.

3.1 Work piece surface

Temperature of work piece should be less than 80℃;

The surface roughness requirements are listed in table 3.1.1

Table: 3.1.1

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

The small support ring or non-conventional support rings are required for work piece with curved surface radius less than 30mm, for details please refer to appendix 4.

3.2 Weight of work piece

No support is required for work piece weight more than 5kg.

Work piece with weight of 2-5kg and also heavier work piece with protruding parts or thin walls should be placed on a solid support. In such a manner, they do not move or flex during testing.

Work piece less than 2 kg should be rigidly coupled with a non-yielding support such as a heavy base plate.

Table 3.2.1 Work piece weight and thickness

Impact Device	Weight (KG)			Minimum thickness of work piece (mm)
	Need coupled	Need support	No need	
D\DC\DL\D+15	0.1-2	2-5	> 5	3
G	0.5-5	5-15	>15	10
C	0.2-0. 5	0.5-1.5	>1.5	1

3.3 Work piece surface hardened layer

If the work piece surface hardened layer is too thin, the impact force of short duration will go through the layer and make the L-value incorrect. The proper depth surface hardened layer is listed below:

Tale: 3.3.1

Impact device	Minimum depth of surface hardened layer
D, DC, D＋15	0.8mm
C	0.2mm

3.4 No strong magnetism on the work piece surface

Strong magnetism will affect the circuit winding greatly, and affect the accuracy of testing results, so it is required to avoid strong magnetism during testing.

4. Selection and performance of impact device

4.1 Selection of impact device

Before testing, users should correctly select the proper impact devices according to testing requirement, work piece size and shape. For details please refer to appendix 1.

4.2 performance of impact devices

a) Loading

Press down the loading tube to lock the impact body.

b) Placement

Place the support ring on surface to be measured and make sure the distance between two test points should be no less than 3mm.

c) Testing

Trigger the release button while the work piece and the impact body are all stable, and the starting force coincides with the axis of the impact body.

5. Functions of DHT-200Plus

5.1 Technical specifications

Display:	320×240 matrix TFT Color LCD display
Meas. Range:	HL 174-900 HRC 19.6-68.0 HRB 13.5-101.7 HS 32.5-99.5 HB 20-655 HV 80-940
Display accuracy:	Error ±0.5%(HL＝800), Repeatability ±0.5%
Memory:	100 customized files X 100 data/each file
Power:	4 AA rechargeable batteries, continuous work 8 hours
Auto turn off:	1Min./ 2Min./ 5Min. and off shutdown
Working Temp.:	－20℃—＋40℃
Storing Temp.:	－30℃—＋60℃
Dimension:	215×145×46mm
Weight:	600g (with battery)

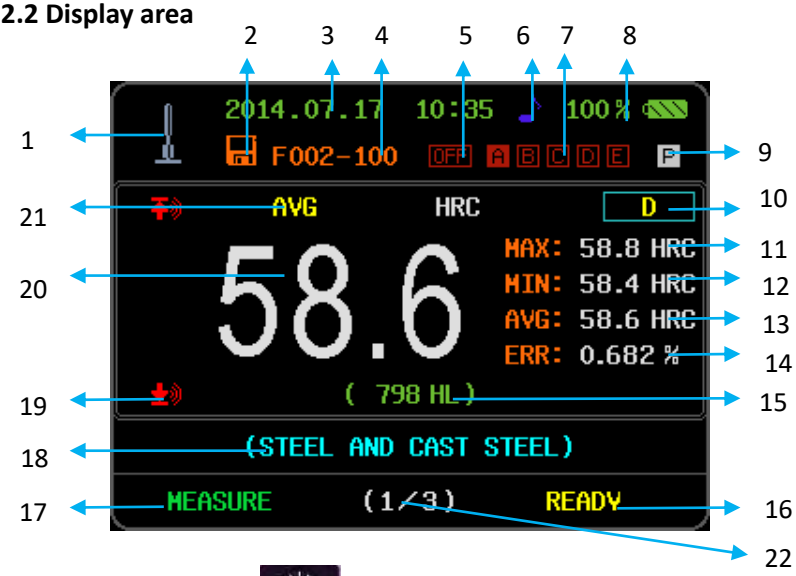
5.2 Nomenclature of DHT-200Plus

5.2.1 Main unit



1. Shell
2. Integrated printer
3. LCD display
4. Battery box/support
5. Reset
6. Keypad
7. Impact device connecting port
8. USB port/charging port

5.2.2 Display area



Prompt: ***Press the***  ***key to change to big digital display.***



1 Impact direction
2 Auto save
3 Date and time
4 Current file
5 Non Work piece mark
6 Sound indication
7 Power indication
8 Work piece mark
9 Print indication
10 Impact device type
11 Max value of testing result
12 Min. value of testing result
13 Avg. value of testing result
14 Measuring relative error
15 Leeb hardness values
16 Instrument state
17 Operation indication
18 Tested material
19 Limits mark
20 Converted values
21 Converted hardness scales
22 Testing times

5.2.3 Keypad



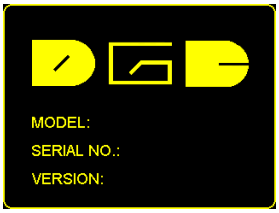
	**1.Power key**	**1.Power on or off the instrument**
	**1.Left Key** 2.Work piece mark key	**1.Adjust the menu items** 2.In measuring status, adjust the mark of work piece (ABCDE)
	**1.Right key** 2.Work piece mark key	**1.Adjust the menu items** 2.In measuring status, adjust the mark of work piece (ABCDE)
	**1.Up Key** 2.Turn on the printer & Print current data	**1.Adjust the menu items** 2.In measuring status, press one time to turn on the printer, press twice to print current data
	**1.Down Key** 2. Turn off the printer	**1.Adjust the menu items;** 2. In measuring status, press one time to turn off the printer
	**1.Menu & confirm key**	**1.Enter into the menu and confirm the settings**
	**1.Menu Esc.** 2.Delete key	**1.Exit menu** 2. In measuring status, delete error values.
	**1.Preview key**	**1.Preview the saved files**
	**1.Display key**	**1.Exchange display**
	**1.Print control key**	**1.Begin / stop Print**
	1.Move Printing paper	**1.** Move the printing paper when printer disconnected with instrument.
	1.Indication light of printer	**1.** Red light: Printer on line Green light: Printer off line

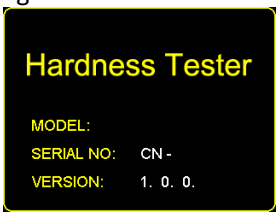
6. Operation instruction

6.1 Power on

Fit on the impact device firstly, press key  to power on. The following information is displayed.

1. Instrument model, Series No., Software version
2. Parameters of last setting

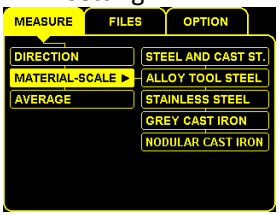


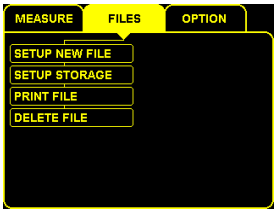


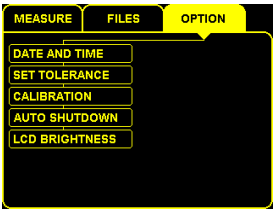
Prompt：If the impact device is not fitted properly, the instrument will not be able to complete self-checking and will give out the Notice.

6.2 Parameters setting

Various parameter settings and management can be accomplished via the instrument menu. Press the  key to Enter the menu, and press the  key or  key to select the setting items. Press the  key to confirm setting.





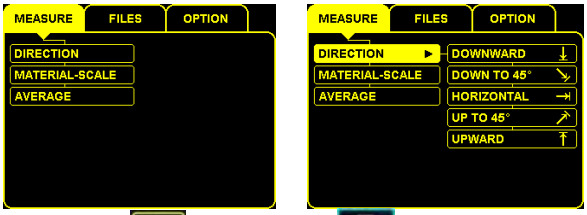


6.3 Measure

“Measure "is available for users to set basic parameters needed in measurement. It can also be changed during the measurement operation.

6.3.1 Impact direction settings

DHT-200 PLUS can be used for hardness measuring in different directions, but different direction meets different requirements, so it is very important to select the proper impacting direction. Normally the direction is DOWN.



-Press the key and the key to enter ***MEASURE- DIRECTION***.

-Press the key to enter this item,

-Press the key or key for setting,

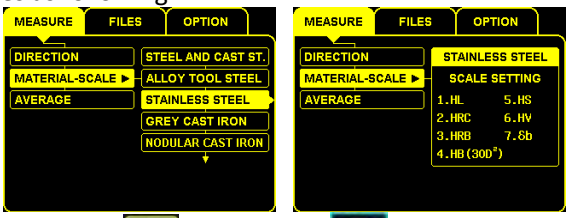
-Press the key to confirm.

Prompt: During measurements, the actual impacting direction must conform to the one selected.

6.3.2 Material and hardness scales settings

During measurement performance, the material set must conform to the actual measured material. DHT-200Plus hardness tester supplies 9 kinds of materials for actual measurement. For each material, there is accordingly different hardness scales. For details, please refer to appendix 2 and 3.

Before measurement, users should firstly confirm the measured materials and the corresponding hardness scales. Set the proper materials and hardness scales as following:



- Press the key and the key to enter ***MEASURE- MATERIAL***.

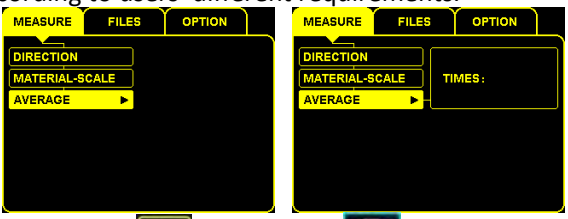
- Press the key to enter this item,

- Press the key or key for setting,

- Press the key to confirm.

6.3.3 Average times settings

It is extremely necessary to work out the average measuring values in leeb's hardness testing. Different measuring times between 2~8 are selected according to users' different requirements.



- Press the  key and the  key to enter ***MEASURE- AVERAGE***.
- Press the  key to enter this item, use the  key or  key to set the desired average times.
- Press the  key to confirm.

Prompt: 3~5 times are usually recommended in normal measurement.

6.4 Files management

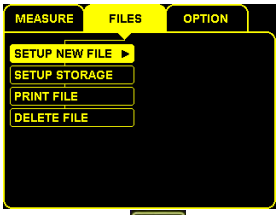
Via "file management", users are allowed to set the file management ways. For example, users can set the saved file codes according to their own requirements.

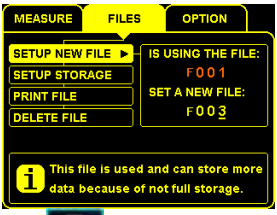
6.4.1 New files settings

Via this sub-menu, users are allowed to set the number of files freely. DHT-200Plus hardness tester supplies users 100 files, which are coded from F001 to F100. Per each file, there is also 100 data storage, which is coded from 001 to 100. For example it shows F001-099 on LCD display, it means the 99th test data in File No. 001.

For the convenience of saving the data for different work pieces, the function of work piece marking is available in the current file. Then users will be able to identify the data of different work pieces saved in the same file.

Users are also allowed to build only one file. When the auto-save is turned on, the indication mark  appears on the screen, and the measured values will be saved in the file in a series of codes. When the memory is full, it will give a prompt and said that "please build another file" or "the memory is over", "please delete the data unused". When a new file is built, the former one will be closed automatically, and at the same time it is featured "read only", which means that users can only read or print out the former file but not write in.





-Press the  key and the  key to enter ***FILES--SETUP NEW FILE,***

-Press the  key to enter this item,

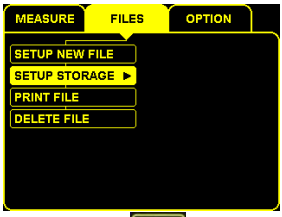
-Press the  key or  key for setting,

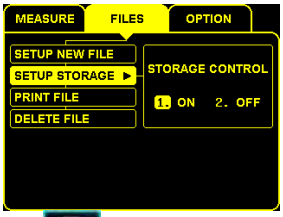
-Press the  key to confirm.

6.4.2 Storage settings

Set the data auto-saving state during measurement by turning on or off.

When data saving is set on “auto saving”, there will be a corresponding indication mark  on the screen, and the measuring values will be stored in the file automatically. Under this condition, the work piece mark can be set to identify them in the same file, maximum 5 different work piece data can be saved in one file.





-Press the  key and the  key to enter ***FILES--SETUP STORAGE,***

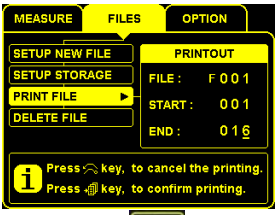
-Press the  key to enter this item,

-Press the  key or  key for setting,

-Press the  key to confirm.

6.4.3 Print file settings

Via this function, the saved data in instrument can be printed out. With this function, users are allowed to print out data in a single file. Before printing, users need to set the file code, start and end address of data stored.





-Press the key and the key to enter ***FILES--PRINT FILE,***

-Press the key to enter this item,

-Press the key or key for setting,

-Press the key to confirm.

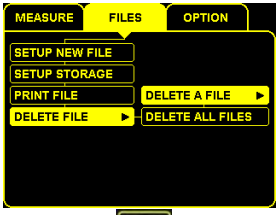
Prompt: For safety of data stored in the main unit, it is suggested that users should transfer all the saved data to PC or print them out after the measurement.

6.4.4 Delete file settings

Via this function, the saved files and data can be deleted.

Both single file delete and all files delete are available.

Delete a file:This will delete all the information saved in one file.





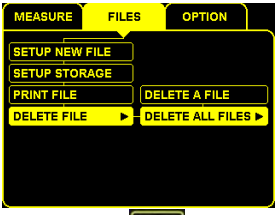
-Press the key and the key to enter ***FILES--DELETE FILE,***

-Press the key to enter this item,

-Press the key or key for setting,

-Press the key to confirm.

Delete all files: It is used to delete all files saved in the instrument.





-Press the key and the key to enter ***FILES--DELETE FILE,***

-Press the  key to enter this item,

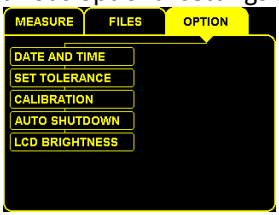
-Press the  key or  key for setting,

-Press the  key to confirm.

Prompt: The deleted files will never be able to come back, so please be careful about your operation.

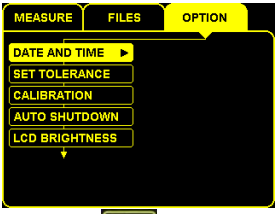
6.5 Other settings

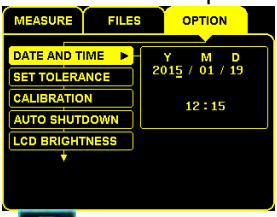
Various optional settings are available for users in the “option” function.



6.5.1 Date and Time settings

Via this setting, users are allowed to set date and time, which will be saved together with other data when transfer to PC or printed out.





-Press the  key and the  key to enter ***OPTION-DATE AND TIME,***

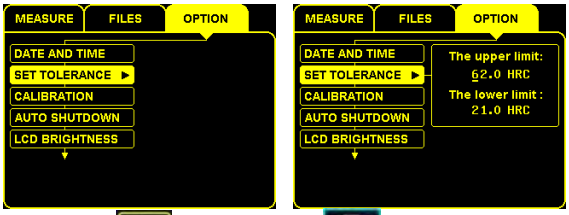
-Press the  key to enter this item,

-Press the  key or  key for setting,

- Press the  key to confirm.

6.5.2 Tolerance settings

During measurements, this function will be very useful for identifying “checked out”. It is automatically turned on. The instrument will give alarming sound and display the limits mark  or  on the left of screen when some measuring values have got over the limits.



-Press the key and the key to enter ***OPTION--SET TOLERANCE,***

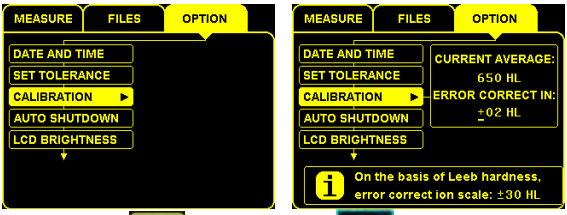
-Press the key to enter this item,

-Press the key or key for setting,

-Press the key to confirm.

6.5.3 Calibration settings

Measuring error can be usually caused by impact device abrasion or changing another impact device. So it is necessary to correct the error and get more accurate value close to work piece. Hardness tester DHT-200Plus supplies users with this function to correct the error mentioned above.



-Press the key and the key to enter ***OPTION--CALIBRATION,***

-Press the key to enter this item,

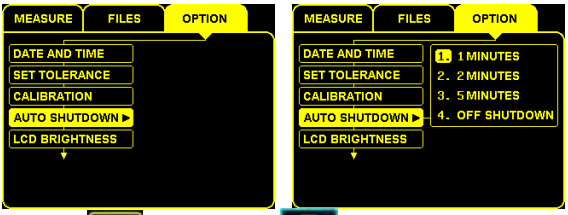
-Press the key or key for setting,

-Press the key to confirm.

Prompt：In actual measurement, adjust the range of within ±30HLD is recommended. If the error is more than that, it is suggested to change the impact body or repair the impact device.

6.5.4 Auto shutdown settings

To avoid wasting of battery power, the instrument is equipped with various kind of turning off functions.



-Press the key and the key to enter ***OPTION--AUTOSHUTDOWN,***

-Press the key to enter this item,

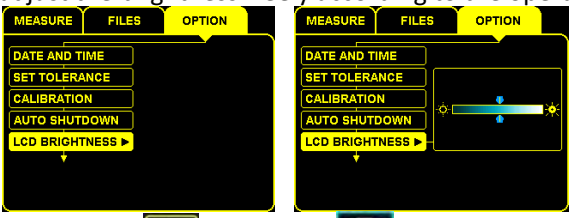
-Press the key or key for setting,

-Press the key to confirm.

Prompt： It is not suggested to use the function of "OFF SHUTDOWN", which consumes more power of batteries, even out of usage.

6.5.5 LCD brightness settings

DHT-200 plus supplies the function of brightness settings of LCD. Users can adjust the brightness freely according to the operation circumstance.



-Press the key and the key to enter ***OPTION--LCD BRIGHTNESS,***

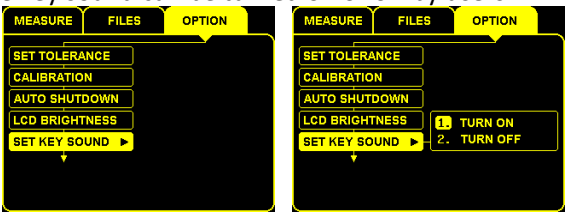
-Press the key to enter this item,

-Press the key or key for setting,

-Press the key to confirm.

6.5.6 Key sound settings

The key sound can be turned on or off by users.



-Press the key and the key to enter ***OPTION--SET KEY SOUND,***

-Press the key to enter this item,

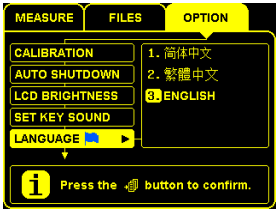
-Press the key or key for setting,

-Press the key to confirm.

6.5.7 Language settings

Multi-languages are offered to clients for convenience in usage.





-Press the key and the key to enter ***OPTION--LANGUAGE,***

-Press the key to enter this item,

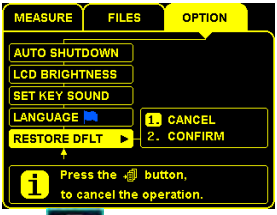
-Press the key or key for setting,

-Press the key to confirm.

6.5.8 Restore default

It is used to renew the factory settings when some terrible parameter settings error appears.





-Press the key and the key to enter ***OPTION--RESTORE DFLT,***

-Press the key to enter this item,

-Press the key or key for setting,

-Press the key to confirm.

6.6 Usage of integrated printer

DHT-200Plus is equipped with micro-printer used for printing out the measuring or saved data; it is a printer with one line 16 characters, baud rate 9600.

6.6.1 Installation of printing paper

1. Press the key  to turn on the printer, and now both the red and green lights will be light, this means the printer is connected.

2. Press the key  to disconnect the printer, the green indication lamp  will be light.

3. Press the key  to move the print paper, lead the paper to go through the paper slot and keep 20mm in length, then press the key  again to stop moving the paper.

4. Install the front cover of printer

5. Press the key  to reconnect the printer and get ready for print.

6.6.2 Printing of one time measurement data

1. When the printer is connected, press  to print the current measuring values.

2. When the printing is finished, the printer will be shut down automatically.

6.6.3 Data output through printer

If print a single file, please refer to 6.4.3.

Prompt: It is suggested not to use the printer when the battery power is low because the printer consumes much power.

6.7 Data output through USB to PC

DHT-200Plus Leeb hardness tester supplies users very powerful USB data port for transferring saved data to PC.

1. Connect the instrument to PC with USB cable, in several seconds you will find a Driver program is installed automatically and new Disk is displayed like a U-disk for storage.

2. Click it, you will find a file. Open it again, all stored data is listed as F001, F002 or something like that. Users could open the file and check the data, or even copy them to any software for further analysis.

6.8 Deleting of wrong measuring data

During measurements, some measuring values are obviously error data; press the key  to delete these values conveniently.

7. Repairing and Maintenance

In order to keep the accuracy and reliability of the instrument, it is necessary of timely evaluation and maintenance.

7.1 Maintenance of battery

The battery of DHT-200$_{Plus}$ should be charged timely to avoid damage. The proper charging time is about 5 to 6 hours. If this instrument is not used for long time, it is suggested to charge once per month to keep live of batteries.

Prompt: During measurements, if the battery power is too low, 4 AA standard batteries can be used temporarily.

7.2 Maintenance of impact body tip

Owing to the abrasion of impact body tip, if it shows within the range of tolerance (±6HLD) on testing the block comes with the delivery, but out of range of repeatability (the maximum value minus the minimum value less than 12HLD), please replace the impact body and do calibration again. If it does not show within the range of tolerance, but repeatability is good, please make change through the Menu CALIBRATION. For details please refer to “6.5.3 calibration”.

7.3 Maintenance of impact device cable

During measurements, the impact cable may be damaged, just replace it with a new one.

7.4 Maintenance of printer ribbon

The ribbon of printer should be changed periodically for clear printing. Users can get the ribbon from local suppliers or from us.

7.5 Maintenance of instrument

The Leeb Hardness Tester DHT-200$_{Plus}$ has endured strict checking. It completely conforms to the national standards and our company standards. The following after sales services are guaranteed:

1. In the first 3 months after purchasing, we supply complete free repairing and exchanging.

2. We supply warranty of 24 months (excluding the easy damaged parts, such as impact devices, cable, Digital display, shell, suit case), and we will be in charge of the repairing and maintenance of our instrument for its whole life.

3. During the warranty term, we will supply cost-free repairing and maintenance services if the malfunction is caused by the manufacturing quality. And when it is out of the warranty term, we will supply the services with collection of charges.

4. Please do not dismantle the instrument sheath by yourself in case receiving permission from manufacture; otherwise any problems arises from that will not be within our service.

8. Packing list

The standard delivery includes:

Code	Content	Quantity
1	Main unit DHT-200 PLUS	1 set
2	Impact device (standard D) including: big/small support rings and brush	1 set
3	Standard Leeb hardness test block	1 Pc
4	USB connecting cable	1 Pc
5	Charger	1 Pc
6	Instruction manual	1 Pc
7	Rechargeable battery (AA)	4 Pcs
8	Carrying case	1 Pc

9. Appendix

Appendix 1: Measuring range

Table 1: Impact Device – D, DC D+15 Measuring Range LD:174-900

Material	HLD	HRC	HRB	HB	HV	HS
Steel	300-900	20.0-68.0	38.4-99.5	80-647	80-940	32.5-99.5
C.W. Tool Steel	300-840	20.4-67.1			80-898	
Stainless ST	300-800	19.6-62.4	46.5-101.7	85-655	85-802	
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		

Table 2: Impact Device – C, Measuring Range LC: 350-950

Material	HLC	HRC	HRB	HB	HV	HS
Steel & Cast St.	350-950	20.0-69.5		80-683	80-996	31.9-99.6

Table 3: Impact Device – G, Measuring Range LG: 300-750

Material	HLG	HRC	HRB	HB	HV	HS
Steel & Cast St.	300-750		47.7-99.9	90-646		
Gray Cast Iron	300-750			92-326		
Nodular Cast Iron	300-750			127-364		

Table 4: Impact Device – DL, Measuring Range LDL: 300-893

Material	HLD	HRC	HRB	HB	HV	HS
Steel & Cast St.	300-893	20.0-68.0	38.4-99.5	80-647	80-940	32.5-99.5

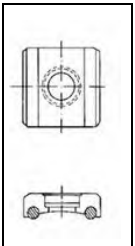
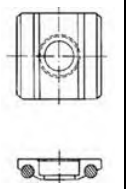
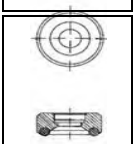
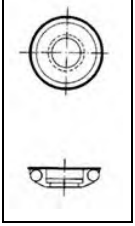
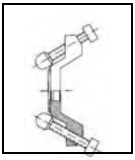
Appendix 2: Features of impact devices

Type	Configuration features	Application
D	Standard configuration	Used for normal measurement
DC	Short size, loaded with loading tube	Used for hardness measurement on local parts of work piece: holes, inner cylindrical face or inner face of solid installed parts.
D＋15	Long size	Used for measuring in grooves or concaved surface
DL	Equipped with extension rod 50mm	Used for hardness testing on the deep section of parts, bottom of a small hole or the base of a gear wheel
C	Light impact force	Used for hardness measurement of work piece with hardened layer.
G	Heavy impact force	Direct hardness measurement on rough surfaces

Appendix 3: Material Applicable table

No	Material	D	DC	D+15	C	G	DL
1	Steel and cast steel	★	★	★	★	★	★
2	CWT.ST	★	★	★			★
3	SST	★	★				
4	GC.IRON	★	★			★	
5	NC.IRON	★	★			★	
6	C.ALUM	★	★				
7	BRASS	★	★				
8	BRONZE	★	★				
9	COPPER	★	★				

Appendix 4: Supporting rings

	Type	Sketch	Remarks
1	Z10-15		For cylindrical outside surface R10-R15
2	Z14.5-30		For cylindrical outside surface R14.5～R30
3	Z25-50		For cylindrical outside surface R25～R50
4	HZ11-13		For cylindrical inside surface R11～R13
5	HZ12.5-17		For cylindrical inside surface R12.5～R17
6	HZ16.5-30		For cylindrical inside surface R16.5～R30
7	K10-15		For spherical outside surface SR10～SR15
8	K14.5-30		For spherical outside surface SR14.5～SR30
9	HK11-13		For spherical inside surface SR11~SR13
10	HK12.5-17		For spherical inside surface SR12.5～SR17
11	HK16.5-30		For spherical inside surface SR16.5～SR30
12	UN		For cylindrical outside surface, radius adjustable R10～∞

Note：We will not play any notification on modification of this manual.