INSTRUCTION MANUAL

HARDNESS TESTER DHT- 400PLUS



V1.0.0

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1. Summary

DHT-400PLUS Leeb hardness tester, based on the principle of Leeb theory, can be used for hardness testing of various metals. With the feature of integrated model, 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.

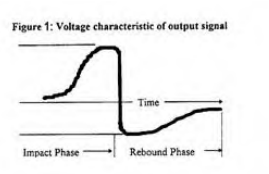


Figure 1 Voltage features of output signal

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

2.3 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, 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 2kg 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/DL	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	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.

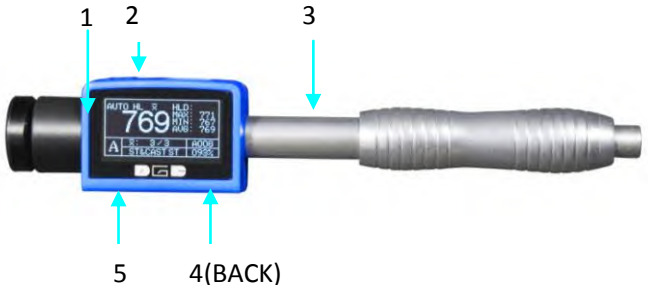
5. Functions of DHT-400PLUS

5.1 Technical specifications

Display:	128×64 matrix OLED 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:	10 customized files X 200 data/each file
Power:	Li-rechargeable batteries, continuous work 16 hours
Auto turn off:	1Min./ 2Min./ 5Min. and never shutdown
Working Temp.:	－20℃—＋40℃
Storing Temp.:	－30℃—＋60℃
Dimension:	215×145×46mm
Weight:	120g (with battery)

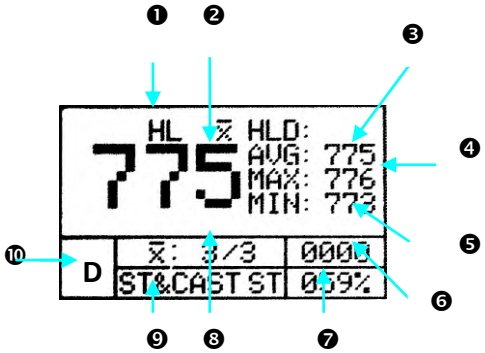
5.2 Nomenclature of DHT-400PLUS

5.2.1 Main unit



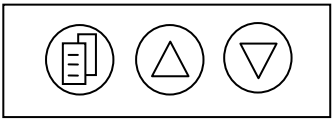
1. OLED display
2. USB port/Charging port/Reset
3. Impact device
4. Name plate (Back)/Indicator of charge
5. Keypad

5.2.2 Display area



❶ Hardness scale
❷ Measuring value
❸ Average value
❹ Maximum value
❺ Minimum value
❻ Memory location
❼ Battery power
❽ Times of measurement/average
❾ Material
❿ Impact device type

5.2.3 Keypad



ON/OFF/Menu/Esc

Select/Move/Change the display to Big digit

Select/Move/Delete

6. Operation instruction

6.1 Power on

Press key to power on. The following information is displayed.

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

HARDNESS
TESTER
Version:

6.2 Parameters setting

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

1. Measurement	4. Tolerance	7. Calibration	10. Standards
2. Average	5. Memory	8. Auto Shutdown	11. Languages
3. Material & Scale	6. Print	9. Contrast	12. Default

6.2.2 Average Times

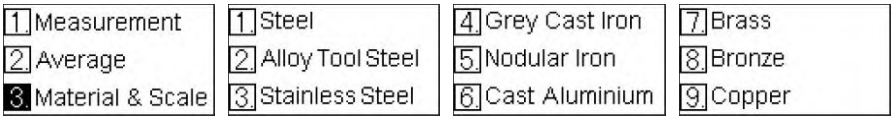
The average times can be selected from 2 to 8.

1. Measurement 2. Average 3. Material & Scale	AVERAGE 3

- Press key and key to enter ***AVERAGE TIMES***.
- Press key to enter this item,
- Press key or key for setting,
- Press key to confirm.

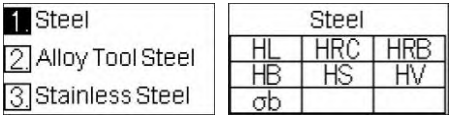
Notice: 3 or 5 average times are to be recommended.

6.2.3 Material and hardness scales settings



- Press key and key to enter ***MEASURE- MATERIAL***.
- Press key to enter this item,
- Press key or key for setting,
- Press key to confirm.

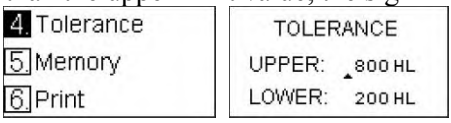
Then hardness scales setting



- Press key or to set hardness scale,
- Press key to confirm.

6.2.4 Tolerance

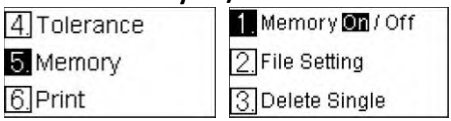
If the measurement value is lower than the lower limit value or upper than the upper limit value, the sign “L” or “H” will appear on the OLED.



- Press key and key to enter **TOLERANCE**.
- Press key to enter this item, use key to set value and key to move the cursor.
- Press key to confirm.

6.2.5 Memory

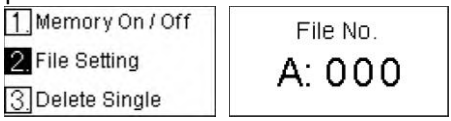
6.2.5.1 Memory on/off



- Press key and key to enter **MEMORY**.
- Press key to enter this item, use key or key to set memory on or off.
- Press key to confirm.

6.2.5.2 File Setting

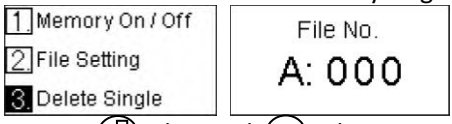
The gauge provides 2000 memory locations in 10 files from A to J, 200 data per each file.



- Press key and key to enter **File Setting**.
- Press key to enter this item, use key or key to set File No. from A to J.
- Press key to confirm.

6.2.5.3 Delete Single

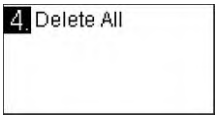
Users could choose to delete any single file.

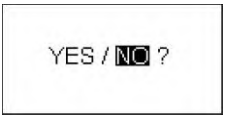


- Press key and key to enter **Delete Single**.
- Press key to enter this item, use key or key to set File No. from A to J.
- Press key to confirm.

6.2.5.4 Delete All

Users could choose to delete data in all files.





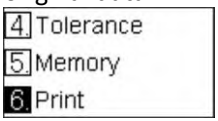
- Press key and key to enter **Delete All**.

-Press key to enter this item, use key or key to set Yes or No.

- Press key to confirm.

6.2.6 Print

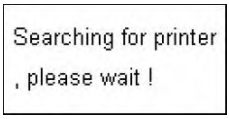
For users' convenience, the gauge offers optional Bluetooth printer to print original data.



6.2.6.1 Print

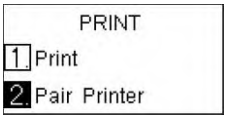
When users purchase the optional Bluetooth printer with DHT-400Plus together, manufacture has already paired them before shipment. Then users could print the data directly.

- Press key and key to enter **Print**.
- Press key to enter this item, use key or key to set File No.
- Press key to confirm



-Then, it reminds of users to urn on the Bluetooth printer and data is printed automatically.

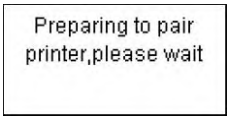
6.2.6.2 Pair Printer

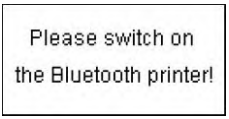


When users purchase DHT-400Plus and optional Bluetooth printer separately, they have to Pair the gauge and printer before printing.

- Press key and key to enter **Pair Printer**.

-Press key to enter this item

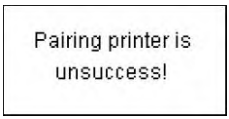




Meanwhile users switch on the printer and gauge of DHT-400Plus pairs printer automatically.

1. If Pair printer is successful, users could print the data follow the step of **6.2.6.1 Print.**

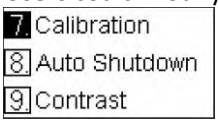
2. If it is unsuccessful like the notice below:

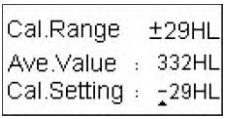


Please repeat **Pair Printer** again until it is successful.

6.2.7 Calibration

Users could modify measurement value when error happened.





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

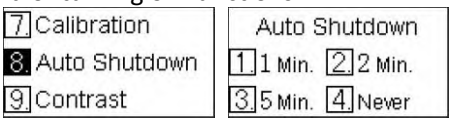
-Press key to enter this item,

-Press key or key for setting,

-Press key to confirm.

6.2.8 Auto shutdown

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



-Press key and key to enter ***AUTO SHUTDOWN,***

-Press key to enter this item,

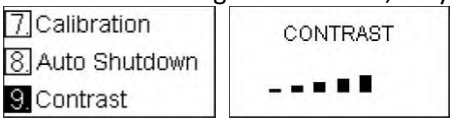
-Press key or key for setting,

-Press key to confirm.

Notice: It is not suggested to use the function of "NEVER SHUTDOWN", which consumes more power of batteries, even out of usage.

6.2.9 Contrast

If users want to change the contrast, they could go to the item and adjust it.



-Press key and key to enter ***CONTRAST,***

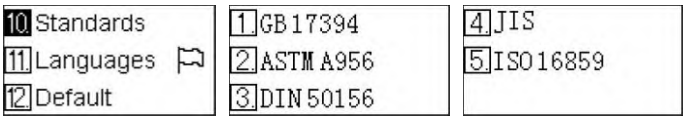
-Press key to enter this item,

-Press key or key for setting,

-Press key to confirm.

6.2.10 Standards

This gauge offers users in Hardness standards option to meet requirements in different countries.



-Press key and key to enter ***STANDARDS,***

-Press key to enter this item,

-Press key or key for setting,

-Press key to confirm.

6.2.11 Languages

The gauge offers multi-languages option for convenience of users.



-Press key and key to enter ***LANGUAGES,***

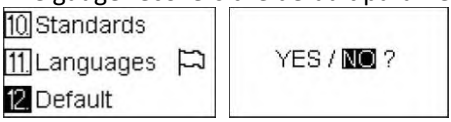
-Press key to enter this item,

-Press key or key for setting,

- Press key to confirm.

6.2.12 Default

The gauge recovers the default parameters when confirm “Default” state.



-Press key and key to enter ***DEFAULT,***

-Press key to enter this item,

-Press △ key or ▽ key for setting,

-Press 🗐 key to confirm.

6.3 Data output through USB to PC

DHT-400PLUS 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.

6.4 Deleting of wrong measuring data

During measurements, some measuring values are obviously error data; press ▽ 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-400PLUS 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.

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 "6.2.7 calibration" on page 11.

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-400PLUS 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-400PLUS	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	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

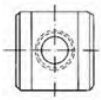
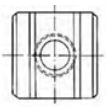
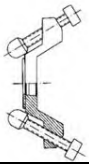
Appendix 2: Features of impact devices

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～∞

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