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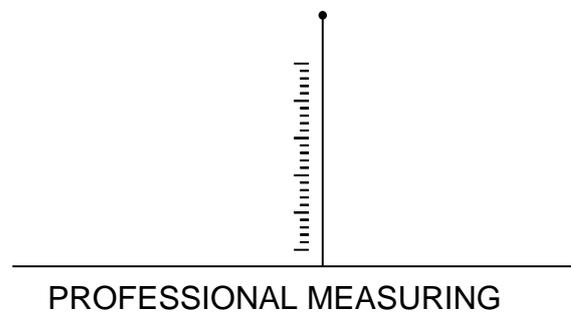
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Instruction Manual Mobile digital Leeb Hardness Tester

SAUTER HN-D

Version 1.5
07/2017
GB



HN-D-BA-e-1715



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Version 1.5 07/2017

Instruction Manual

Mobile digital Leeb Hardness Tester

Thank you for buying a mobile digital Leeb hardness tester of company SAUTER. We hope you are pleased with your high quality instrument and with its big functional range. If you have any queries, wishes or helpful suggestions, do not hesitate to call our service number.

Summarize:

1	Summary	3
1.1	Measuring Principle Scope	3
1.2	Hardness Value „L“	4
1.3	Features.....	4
1.4	Applications	4
1.5	Primary Industries	4
2	Technical Specifications	5
3	Instrument’s views.....	5
4	Checking Supplied Accessories.....	5
5	Operation Instruction	6
5.1	Keys and their Functions	6
5.2	LCD Display	6
5.3	Settings	7
5.3.1	Material Type	7
5.3.2	Hardness Scale	7
5.3.3	Data in One Group	8
5.3.4	Browse Data	8
5.3.5	Setting Date and Time.....	8
5.3.6	Calibration	9
5.4	The Format of Memory Data	10
5.5	Backlight	10
5.6	Automatic Shut-Off.....	10
5.7	Charging.....	10
6	Data Printing	11
7	Hardness Testing.....	11
7.1	Checking of Settings.....	11
7.2	Sample Preparation.....	12
8	Troubles and solutions	13
9	Maintenance and Service	13
9.1	Impact Device Maintenance	13
9.2	How to Store the Reports	13
9.3	Normal Maintenance procedures.....	13

Cautions

Please carefully read this first

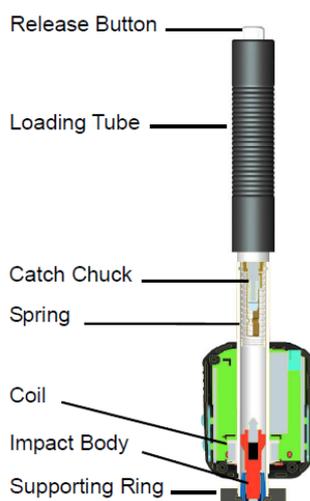
1. Any components of the instrument may not be submerged into water or exposed to rain, which could cause a battery explosion or the display might be damaged.
2. If the instrument isn't used for a longer period, it should be stored in dry environment and in its original transport case. The environmental temperature should be within the range of -30°C up to $+80^{\circ}\text{C}$ and relative humidity from (RH) 5% bis 95%.

1 Summary

1.1 Measuring Principle Scope

When the test is carried out, an impact body with a tungsten carbide test tip is being impelled by spring force against the surface to be tested, from which it rebounds. Impact and rebound velocities are measured by the following method: a permanent magnet integrated in the impact body passes through a coil and induces an electric voltage during its travel back and forth. These voltages are proportional to the velocities and are processed and displayed as the hardness value "L" at the instrument. Modern electronics with power saving features provide a long operating life.

Illustration



The big-sized LCD display always shows how the HN-D is configured to test. Variable function keys allow quick changes of common test parameters. No subjective measuring errors are possible, giving highly repeatable results. Internal self diagnostics with error messages assure reliable test results.

Readings can be stored automatically in the internal memory or being directly sent to a printer. PC evaluation software enables a data analysis. These conversions to other scales (HRC, HRB, HB, HV, HSD etc.) are programmed into the electronics and can be shown directly on the display as test result.

1.2 Hardness Value „L“

This term, 1978 introduced by Dr. Dietmar Leeb into measuring technology, is the quotient for the impact body's rebound and impact velocity, multiplied by 1000. Harder materials produce higher rebound velocities than less harder ones. With reference to a particular material group

(e.g. steel, aluminium etc.) The L-value represents a direct hardness measurement and it is used as such. Comparison curves with standard static hardness values have been established (Brinell, Vickers, Rockwell C, B, Shore D) for the most prevalent materials, enabling the L-value to be converted into the relevant values for these procedures. With HN-D, such hardness values can be directly displayed in the hardness scales HLD, HRC, HRB, HB, HV, HSD.

1.3 Features

- HN-D is the most advanced integrated tester (which means that the impact device D is integrated): no cables
- Integrated impact direction sensor
- High accuracy (± 4 HL) in any impact direction (360°) – automatically
- Integrated display of results for all common hardness scales
- Large high-contrast LCD for an optimum viewing in all conditions
- Easy calibration
- Full USB communication with PC, internal storage of data with day and time
- Rechargeable Li-ion battery, charges through USB port
- Intelligent sleep mode
- Wireless (Bluetooth) to mini printer possible

1.4 Applications

- Convenient for all materials
- Best suited for on-site testing of heavy, big or already installed parts
- Handy for difficult to access confined test locations
- Automatic sensing and compensation for impact direction
- Excellent for material selection and acceptance tests.

1.5 Primary Industries

- Metal production & processing
- Automotive & transportation

- Machinery & power plants
- Petro-chemical, refinery
- Aerospace & shipyard
- Metal constructions testing services & laboratories

2 Technical Specifications

- Indication range: 0 to 999 HLD
- Accuracy: ± 4 HLD
- Measuring direction: any direction
- LCD display: 128 x 64 dot LCD with backlight
- Data memory: 500 groups
- Measurement results can be automatically converted into HRC, HRB, HB, HV, HSD
- Impact energy: 11N
- Weight of the impact body: 5.5 g
- Impact tip: Diameter: 3mm
Material: tungsten carbide
Hardness: ≥ 1600 HV
- Power: Li-ion rechargeable battery
- Charger: DC 5V/500mA or USB port
- Maximum continuous working time: approx. 16 hours
- Operating environment: - Temperature: -10°C to $+60^{\circ}\text{C}$
- Humidity: 5% bis 95%
- Dimensions: 147 x 35 x 22 mm
- Weight: 63 g

3 Instrument's views



4 Checking Supplied Accessories

You'll have to check in advance whether you obtained all accessories in the delivery of the HN-D. Other accessories, not included in delivery, can be disposable at any time by SAUTER GmbH. All items should be only used with the original, authorized

instruments. The use of these accessories with other instruments could cause problems and any repair costs would not be covered by warranty.

Packing list:

- Robust carrying case
- HN-D Metal hardness tester
- USB Cable
- Charger for HN-D
- Small support ring
- Cleaning brush
- Instruction Manual (CD)

Note: The test block is not included in the delivery!

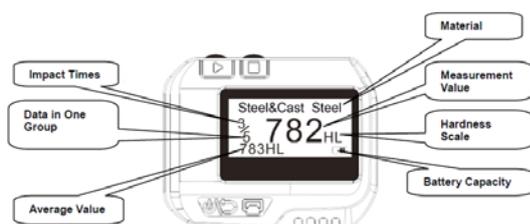
5 Operation Instruction

5.1 Keys and their Functions



1. ▷ **“Next“**, select material, scale etc. can be used...
2. □ **Menu & Select“**
3. 🖨️ **“Print“**
4. 🔌 **„ON / OFF & Back“**
5. □+ 🔌 : **„Hardness Calibration“**: press and hold □, then press 🔌 for 2 seconds to display the calibration mode.
6. 🖨️ + □: **„Delete“**: Press and hold 🖨️, then press □ to delete the current data.
7. ▷+ 🔌: **„Set date and time“**: in shut-off state, press and hold ▷, then press 🔌 to set date and time.
8. 🖨️ + ▷: **„Data browse“**: Press and hold 🖨️, then press ▷ to enter data browse.

5.2 LCD Display



5.3 Settings

5.3.1 Material Type

In measurement mode, press \square three times and the material character will highlight, and then press \triangleright to select the material type. It changes according to the following sequence:

Steel & Cast steel → Alloy Tool Steel → Stainless Steel → Grey Cast Iron → Ductile Iron → Cast Al Alloys → Cu-Zn Alloys → Cu-Sn Alloys → Copper → Forging Steel → Steel & Cast steel →....



Note: 1. It is necessary to select this classification. If the material type is not known, it has to be referred to the handbook.

2. When you change the material group, the impact times counter will be set to "0" again.

5.3.2 Hardness Scale

In measuring mode, the button \square has to be pressed twice, then the hardness scale character will be highlighted. It has to be pressed \triangleright to select the hardness scale; The hardness scale changes according to the following sequence:

HLD → HB → HRB → HRC → HV → HSD → HLD....

Illustration: highlighted Hardness Scale character



HLD= Leeb Hardness

HB= Brinell

HRB= Rockwell (B)

HRC= Rockwell (C)

HV= Vickers

HSD= Shore Hardness (D)

Note:

1. The value "---" means „out of range“.

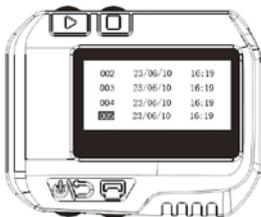
2. The default hardness scale is HLD.

5.3.3 Data in One Group

In measurement mode, the button  has to be pressed four times, the „Data in One Group“ character will be highlighted; then  has to be pressed to set the number. The maximum number is 9.

5.3.4 Browse Data

1. To browse the data in the current group: in measurement mode, the button  has to be pressed once, the “impact time” character will be highlighted. Then the button  has to be pressed to browse the data in the current group.
2. Browse the historical data: in measurement mode,  has to be pressed and held. Then  has to be pressed to display the historical data browse mode.



By pressing the button , the next group can be selected and by pressing the button , the previous group can be selected. If the button  is pressed, the selected data can be browsed: By pressing the button , the next group can be selected and by pressing the button , the previous group can be selected. You can return to the previous menu by pressing the button .

Illustration: Browsing the data group:



5.3.5 Setting Date and Time

The HN-D has got a built-in real-time-clock. Clock and calendar have to be adjusted if it is necessary. The procedure is as follows:

In shut-off mode, the button  has to be pressed and held, then  has to be pressed for about 3 seconds to enter the date and time setting mode.



Press  to increase the „day“ from 1 to 31, press  to decrease the “day” from 31 to 1. Press  to set the month. Then press  to increase the month from 1 to 12 and press  to decrease the month from 12 to 1. The same way is used to set the year,

hour, minute and second. In the “second “ set-up process, the setting will be finished by pressing the button  and the instrument returns to the measuring mode.

5.3.6 Calibration

Calibration is used to calibrate the measured value (HLD) of the hardness tester up to the minimum measuring error. The procedure is as follows:

1. When the instrument is turned off, the button  has to be pressed and held; then  has to be pressed and held for about 3 seconds to display the calibration mode.



Now, 5 tests have to be performed on the test block to get the average value of these values.

2. By pressing the button , the 5 measured values can be browsed and by pressing the button , the error values can be deleted.

3. If the button  is pressed, it can be started to input the value written on the test block: Primary, the „hundred“ bit has to be set (see illustration below).



4. By pressing the button , it can be increased from 0 to 9 to set the “hundred” bit.
5. By pressing the button , the „ten“ bit will be highlighted. By pressing the button , it can be increased from 0 to 9 to set this bit.



6. By pressing the button , the “one” bit will be highlighted. By pressing the button , it can be increased from 0 to 9 to set this bit.



7. If the button  is pressed, the instrument returns to the measurement mode and the calibration is finished.

Note: 1. Before the first use, the hardness tester has to be calibrated on the test block.

2. The impact direction has to be set straight down.

5.4 The Format of Memory Data

The data (such as hardness value, scale, sample material and impact direction, time, date etc.) will be saved in the memory automatically after each individual impact. HN-D can store 500 data. When the test times are more than 500, the last data will be stored in the 1st position and the first date will be erased, simultaneously the position of other data will be automatically moved into the lower position.

5.5 Backlight

LED backlight is used for poor light conditions. If there is no impact performed or any key operation has taken place in 3 seconds, the backlight will be turned off automatically. When testing continues or any key is pressed, the backlight will be turned on again.

5.6 Automatic Shut-Off

If there is no measurement performed and no key operation takes place for 3 minutes, the display unit will automatically switch off in order to saving battery power. All the parameters will be automatically stored before turning off.

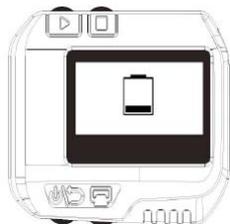
5.7 Charging

Batteries have to be recharged when they are used for the first time or an exhaustion of electricity arises. First the HN-D has to be connected with the charger by using the USB cable, then the charger has to be connected with the AC socket to start charging.



Fig.5-14

Meanwhile the screen will display the charging mode:



There can also be used other USB devices (e.g. Laptop) to charge the HN-D. Charging time is 2 to 3 hours.

If charging is finished, the following is displayed on the screen:



6 Data Printing

HN-D can be linked with the exclusive Bluetooth Mini printer to print out the measured values. The maximum distance between the hardness tester and the printer is three meters. When the printer is turned on,  has to be pressed to print out the current data.

Der HN-D kann mit dem optional erhältlichen Bluetooth Minidrucker verbunden werden, um die Messdaten auszudrucken. Der maximale Abstand zwischen HN-D und dem Minidrucker beträgt drei Meter. Ist der Drucker angeschaltet, so ist nur die Taste zu betätigen, um die laufenden Messdaten auszudrucken.

Mini Printer SAUTER AHN-01, www.sauter.eu



A complete test report is shown below:

```

-----
Test Report
-----
Impact Unit Type: D
Material : Steel&Caststeel
1 808 HLD ↓ 61.2 HRC
Date: 06/07/31 Time: 18:21:27
2 808 HLD ↓ 61.2 HRC
Date: 06/07/31 Time: 18:21:27
3 805 HLD ↓ 60.8 HRC
Date: 06/07/31 Time: 18:21:27
4 808 HLD ↓ 61.2 HRC
Date: 06/07/31 Time: 18:21:27
5 805 HLD ↓ 60.8 HRC
Date: 06/07/31 Time: 18:21:27
-----
s = 3 HLD 00.4 HRC
x̄ = 806 HLD 61.0 HRC
Printed: 06/07/31 18:21:27
-----

```

7 Hardness Testing

7.1 Checking of Settings

The button  has to be pressed to turn on the instrument. First, it has to be checked if it has to be charged. Then, it has to be inspected if every setting is

correctly, particularly material type and scale. If the setting is inconsistent with the actual conditions, a great error might be caused.

7.2 Sample Preparation

Inappropriate samples will cause great measurement errors. Therefore, preparation and handling should be performed on original conditions of the sample.

Preparation of the sample and the surface to test should be coincident with the following basic requirements:

- 1) A thermal or cold processing of the impact sensors during the process of sample preparation should be avoided.
- 2) The surface of the sample should be plane, with a metallic sheen, and not involve oxide layer or other stains.
- 3) Roughness of the test surface: $Ra \leq 1.6$
- 4) The sample has to be of sufficient quality and rigidity. Otherwise displacements or shaking during the test might happen. These could also lead to measurement errors. A sample quality of ≥ 5 kg can be directly tested. If the sample quality is 2~5 kg, it should be fixed before the test by appropriate clamps. If the sample quality is 0.05~2 kg, it should be coupled before the test; if it is < 0.05 kg, this hardness tester is inappropriate to use.

Coupling method: The testing sample's back should be plane as well as the surface of the supporting object.

A little coupling substance (i.e. Industry Vaseline) has to be filled between the two components. Then the two parts have to be pressed together. If the weight of the supporting object is more than 5 kg, it can be replaced by the test block.

- 5) Samples should be thick enough with sufficient layered surface. If the D-type of impact sensor is used, the thickness of the sample should be less than 5 mm and the surface absorption layer (surface- hardening layer) should not be less than 0.8 mm. To perform accurate hardness measurements, the best way is to remove this layer before testing.
- 6) If the testing sample surface isn't horizontal and flat, the curvature radius of the testing and nearby surface should be larger than 30 mm. An appropriate supporting ring has to be selected and installed.
- 7) A sample should not be magnetic. The signal of the impact sensor would be seriously affected, which might cause inaccurate test results.

A long operating life is provided by modern electronics with power saving features. The large LCD display always shows how HN-D Impact Hardness Tester is configured to the tests. Variable function screen allows a quick change of common test parameters. On the screen hint line the other active control keys are positioned. No subjective measuring errors are possible, highly repeatable results are given to the user. Reliable test results are assured by internal self diagnostics with error messages.

Readings can be stored automatically in the internal memory or can be directly sent to a printer. PC evaluation software allows for data analysis.

Tests in more points can be carried out by repeating the above steps 1 to 4.

8 Troubles and solutions

No.	Trouble	Reasons	Solutions
1	No response switched	Lack power	Charge the battery
2	Abnormally high results	Test tip wearing	Replace the test tip
3	No test results	Coil damage	Contact agencies
4	Printer no response	Beyond the transmission range	In the 3 meters

If there may occur any other failures or defects, please don't hesitate to contact SAUTER GmbH. We will care for your problems with the HN-D as soon as possible.

9 Maintenance and Service

9.1 Impact Device Maintenance

After 1000- 2000 times use, the impact device and the impact body should be cleaned with a nylon brush. The screw of the supporting ring has to be turned off before the catheter can be cleaned. Then the impact body has to be taken out and it has to be rotated into the tube with the nylon brush in anti-clockwise direction. The brush has to be pulled out when touching the bottom. This procedure has to be repeated several times. Then the impact body has to be loaded and the supporting ring reinstalled. The impact body should be released after use. The use of any lubricant is banned.

9.2 How to Store the Reports

Printing paper is thermal paper and it should be preserved to avoid heat and direct light. If the print records are necessary to be kept in long-term conservation, they should be copied and preserved in time.

9.3 Normal Maintenance procedures

If the error is larger than 12HLD by calibrating the hardness tester, the steel ball or the impact body has to be renewed. Those parts may be worn out and this may lead to failure in operation.

In case if any other abnormal phenomena occur to the Hardness Tester, it should not be either demolished or any fixed assembly parts may not be adjusted. Instead, just contact our company, send your instrument to our address. We will care for a prompt checking and if necessary, repair of the device.

Appendix 1 Daily Checking

The test block (optional available) is mainly used to calibrate the Hardness Tester. The error and repeatability of it should be in the scope defined in following table:

Impact Device	Impact direction	Hardness of Test block (HL)	Error Allowed	Repeatability Allowed
D		750~830	±12HLD	12HLD
		490~570	±12HLD	12HLD

Note:

1. Error=HLD-HLD

HLD is the mean value of 5 Leeb Hardness values measured on the test block.

HLD is the value marked on the test block.

2. Repeatability= HLD_{max}-HLD_{min}

HLD_{max} is the maximum value of 5 Leeb Hardness values measured on the test block.

HLD_{min} is the minimum value of 5 Leeb Hardness values measured on the test block.

Appendix 2 Factors affecting the Accuracy

Incorrect operation or improper testing conditions can seriously affect the accuracy.

The following factors are the main accounts in lack of accuracy:

1) Roughness of sample surface

When the impact body impacts on the sample, a small pit will arise on the surface of it. The less roughness, the less consumption of impact energy is needed. According to this, the roughness of the surface should be $Ra \leq 1.6$.

2) The shape of the sample surface

Leeb testing principle demands that the velocity of rebound and impact are on the same line, because the impact body is moving in a metal tube. Of course, hardness can also be shown if the velocity of rebound and impact are not on the same line. In this case, the impact body would collide with the tube wall when it rebounds, which will affect the velocity of rebound. This will cause an error on test accuracy. If the radius of curvature of the sample surface is smaller, a suitable variant supporting circle has to be used. We can contribute to design and release those supporting circles, if needed.

3) The weight of the sample

If the weight of the sample is more than or equal to 5 kg, testing can be directly started. If it is less than 5 kg, the sample needs a special charge. The supporting piece has to be coupled by a coupling medium and pressed onto the surface of the test piece. By doing this, better test results will be achieved.

The area of the testing points should be free of vibrations or shaking. If the weight of the sample is not enough, supporting, coupling and compressing must be increased to avoid jitter and sloshing. Shocks should be avoided.

4) The sample stability

Any effective tests need to minimize possible interference from outside. This is very important for dynamic measurements, such as Leeb Hardness testing. Therefore, measurements are only allowed in a stable hardness testing system.

Appendix 3 Measuring Range

Materials	HV	HB	HRC	HRB	HSD
Steel & Cast Steel	81-955	81-654	20.0-68.4	38.4-99.5	32.5-99.5
Alloy Tool Steel	80-898		20.4-67.1		
Stainless Steel	85-802	85-655	19.6-62.4	46.5-101.7	
Grey Cast Iron		63-336			
Ductile Iron		140-387			
Cast Aluminum Alloys		19-164		23.8-84.6	
Cu-Zn Alloys (Brass)		40-173		13.5-95.3	
Cu-Sn Alloys (Bronze)		60-290			
Copper		45-315			
Forging Steel	83-976	142-651	19.8-68.5	59.6-99.6	26.4-99.5

DESIGNED IN REGARD TO THESE STANDARDS:

DIN 50156 (2007), ASTM A956 (2006), GB/T 17394 (1998), JB/T 9378 (2001), JJG 747 (1999), DGZfP Guideline MC 1 (2008), VDI/VDE Guideline 2616 Paper 1 (2002), ISO 18625 (2003), CNAL T0299 (2008), JIS B7731 (2000).

Annotation:

To have a look at the CE Declaration of Conformity, please click onto the following link: <https://www.kern-sohn.com/shop/de/DOWNLOADS/>