Sauter GmbH
Ziegelei 1
D-72336 Balingen
e-mail: info@kern-sohn.com
Phone : +49-[0]7433- 9933-0
Fax: +49-[0]7433-9933-149
Internet: www.sauter.eu

Instruction manual mobile Leeb hardness tester

SAUTER HN-D

Version 2.0
04/2020
GB

PROFESSIONAL MEASURING

GB

SAUTER HN-D

V. 2.0 04/2020

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Thank you for purchasing the mobile digital Leeb impact hardness tester from SAUTER. We hope that you will be very satisfied with the high quality of this device and its extensive functionality. For any questions, wishes and suggestions we are at your disposal.

Table of contents:

1 Before commissioning

Before putting the device into operation, check the delivery for any transport damage to the packaging, the plastic case and the device itself. Should this be the case, SAUTER must be contacted immediately.

Cautions
Please read the following carefully first:

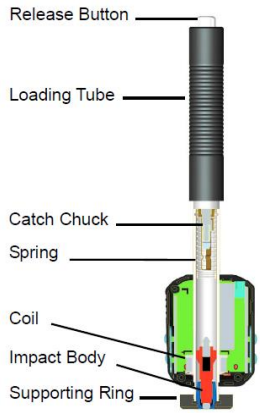
1. the complete device must not be immersed in water or exposed to rain, which could cause unforeseeable damage, the battery or the display could be destroyed
2. if the device is not used for a longer period of time, it should be stored in a dry and cool place, preferably in its original packaging. The ambient temperature should be in the range of -30°C to +80°C and the relative humidity (RH) 5% to 95%.

2 Summary

2.1 Application area Measuring principle

When the test is performed, a rebound body with a tungsten carbide test tip is driven with spring force against the surface of the test object from which it rebounds. The impact and rebound velocities are measured in the following manner: A fixed magnet in the rebound body generates an induced voltage in the simple wire coil of the rebound body during the forward and backward movement. The voltage of the signal is proportional to the speed of the rebound sensor. The signal processing by the electronics ensures that the hardness value L can be read on the display and stored. Modern electronics with energy-saving features ensure a long service life of the hardness tester.

Figure



The LCD display shows how the HN-D is designed (configured) for the test. Various function keys allow a quick change of the test settings. No subjective measurement errors are possible, as the device has a high repetition frequency of the measurement results. Internal self-diagnostics with error messages ensure a reliable measurement

result. Readings can be automatically deleted from the internal memory or directly forwarded to a printer. The PC evaluation software enables data analysis.
These conversions to other hardness scales (HRC, HRB, HB, HV, HSD etc.) are programmed into the electronics and can be shown directly on the display as test results. All data are stored in the original L-scale to eliminate possible errors with other conversions.

2.2 Hardness value "L

This value was introduced to measurement technology in 1978 by Dr. Dietmar Leeb. It represents the quotient of the impact speed of the rebound sensor and the rebound speed, multiplied by 1000.
Harder materials produce a higher rebound speed than less hard materials. With reference to a certain group of materials (e.g. steel, aluminium etc.) the L-value represents a direct hardness measurement value and is also used as such. Comparison curves with standard static hardness values have been set up for the most common materials (Brinell, Vickers, Rockwell C, B, Shore D). This enables the L-values to be converted to the corresponding other hardness values.
With the HN-D hardness tester such hardness values can be shown directly in the hardness scales HRC, HRB, HB, HV, HSD on the display.

2.3 General characteristics

- This is a highly advanced measuring device (rebound sensor D is integrated): no cables
- High measuring accuracy (± 4 HL) in each rebound direction (360°) automatically compensated
- Integrated display for measuring results with conversion to all common hardness scales.
- Large, high-contrast display for optimal visibility in all conditions.
- Easy to calibrate
- Full USB communication with PC possible, internal data storage with date and time.
- Rechargeable Li-ion battery to be charged through the USB port.
- Intelligent "sleep" mode

2.4 Scope of application

- suitable for all metals
- suitable for testing heavy, large or already installed parts on site
- handy to get to test positions that are difficult to access or limited
-automatic compensation of the alignment of the rebound sensor
- excellent for material selection and acceptance tests

2.5 Application: Primary industries

- Metal production and development
- Self-propulsion and transport
- Machinery industry & power plants
- Oil industry, chemical industry, refineries
- Aviation & Shipbuilding
- Metal constructions
- Test operations & laboratories

3 Technical execution

- Display range: 170 to 9 HLD
- Accuracy: ±4 HL (at 800 HLD)
- Measuring direction: all directions possible
- LCD: large, (128 x 64 dot) backlit LCD
- Data memory: 500 measuring groups
- Measurement results can be automatically converted
 will be in: HRC, HRB, HB, HV, HSD
- Impact energy: 11N
- Weight of the rebound body: 5,5 g
- diameter of the test tip: 3mm
 Material of the test tip: tungsten carbide
 Hardness of the test tip: ≥ 1600 HV
- Power source: Li-ion rechargeable battery
- Charger: DC 5V/500mA or USB connector socket
- Maximum continuous operating time: approx. 16 hours
- Operating temperature: -10°C to +60°C
- Air humidity: 5% to 95%.
- Dimensions: 147 x 35 x 22 mm
- Weight: 63 g

4 Device view

5 Check the supplied accessories

It should be checked in advance whether all accessories have been supplied properly. The various optional parts can be purchased at any time from SAUTER GmbH. These should only be used with approved equipment. This could cause problems with other measuring instruments and the repair costs cannot then be covered by the warranty.

Packing list:

Attention: The test block is <u>not</u> included in the delivery!

- sturdy carry case
- HN-D hardness tester for metals
- USB cables
- Charger for HN-D
- Small stabilizing ring
- Cleaning brush

6 Instructions

6.1 Keys and their functions

1st **"Next"**, for material selection, hardness scale...
2nd **"Menu & Selection"**
3. **"Print"**
4. **switch on/off & back**
5. **+** : **"Hardness calibration":** press down and hold, then press for 2 seconds to enter calibration mode.
6. **+**: **"Delete":** press and hold down, then press to delete the current data.
7. **+**: **"Date and time setting":** press and hold down when the unit is switched off, then press to set the date and time
8 **+**: **"Browse data":** press and hold down, then press to enter the data browse mode.

6.2 LCD display

6.3 Settings

6.3.1 Material type

In measuring mode, ❐press three times to show the material type on the display. The desired material type can now be selected ▷with the key. This changes in a certain sequence, namely

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: It is necessary to define the material classification. If the material type is not known, the material manual can be consulted.
If the material group is changed, the rebound counter starts at "0" again.

6.3.2 Hardness scale

In measuring mode, press the key❐ twice, then the field of the hardness scale is backlit. The ▷desired hardness scale can now be selected with the key. The order of the available hardness scales always changes as follows:
Figure: Hardness scale range backlit

HLD→HB→HRB→HRC→HV→HSD→HLD....

HLD= hardness Leeb
HB= Brinell
HRB= Rockwell (B)

HRC= Rockwell (C)
HV= Vickers
HSD= Shore hardness (D)

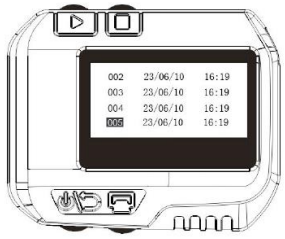
Note:
If the symbol "---" appears, means: out of range.
The standard hardness scale is always HLD.

6.3.3 Data in a measuring group

In the measuring mode, press the key ❐four times to backlight the field for the measurement data groups. Press the key to ▷enter the desired number for the data in a measurement group, the maximum number being 9.

6.3.4 Searching (browsing) data

1. search the measurement data in the current, running measurement group
In measuring mode, press the key ❐once to backlight the rebound field. Then the key is ▷pressed and the current measuring group can be searched.
2. search older data: In measuring mode, ❐press and hold the key. The key is then ▷pressed to display the mode of older data.

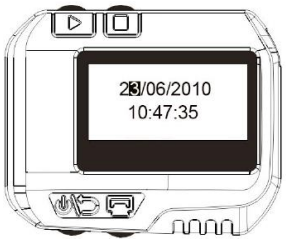


Pressing down ▷will select the next group and pressing will select ❐the previous one.
Use the key to search the selected group.
Press the button to ▷search the next group and the button to search ❐the previous one.
If the key is pressed, the previous menu is entered.
Figure: Searching the measurement data group

6.3.5 Setting the date and time

This hardness tester has a built-in real time clock. The date and time can be set in the following way if required:
When the power is off, press the button ▷, then press and hold the button for about 3 seconds to enter the date and time mode.

By pressing the key in succession, it is possible to select days of the month from 1 to 31 in ascending order, and by pressing the key in descending order from 31 to 1. The month is set by pressing the key downwards, and by pressing the key downwards, it is possible to select months in ascending order from 1 to 12, and by pressing the key in descending order from 12 to 1. The same procedure is used to set the year, hour, minute and second.



When the seconds setting process has been reached, pressing the key ends this setting and returns to the measuring mode.

6.3.6 **Calibration**

Calibration must be performed to calibrate the measured value (HLD) of the hardness tester in order to keep any measurement errors as small as possible.

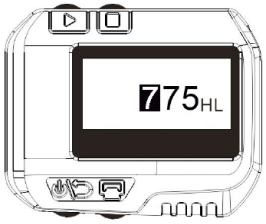
The procedure is as follows:

1. with the instrument switched off, press and hold the button and simultaneously press the button for three seconds to enter calibration mode, see figure

Now 5 tests are made on the test block to get the average value of the same.

2. 5 test measurements can be viewed one after the other by pressing the key and the faulty measurements can be deleted with .

3. press the key to set the value imprinted on the test block: first the 100 digit step lights up.



4. by pressing the key it can be changed and entered from 0 to 9.

5. when the key is pressed, the 10-digit binary digit lights up This can be changed and entered from 0 to 9 by pressing the key.

6. pressing the key lights up the 1 digit binary digit. This can be changed and entered from 0 to 9 by pressing the key.

7. pressing the key ends the calibration and returns to the measuring mode.

Note: Before using the hardness tester for the first time, it is essential to calibrate it on the test block with the impact direction always straight (vertical, at right angles to the test block) downwards.

6.4 Format of the stored data

The data, such as hardness value, scale, material sample, rebound direction, time, date, etc. are automatically stored in the memory after each measurement. The HN-D can store 500 measurement data. If the number of tests is higher, the last measurement is placed in the first position and the previous first position is deleted. The same procedure is followed with each subsequent measurement: it is moved to a lower position.

6.5 Backlit display

In case of sparse or poor lighting, the LED backlight function is used. However, this switches off again if no key is pressed within 3 seconds. During testing or when keys are pressed, this function becomes active again immediately.

6.6 Automatic switch-off

If no measurement is taken for three minutes or no key is pressed for three minutes, the instrument switches off automatically to save the batteries. All parameters are always stored automatically before.

6.7 Recharge

Before first use and before the battery voltage is exhausted, the batteries must be charged.
To do this, connect the HN-D and the charger using the USB cable and then plug the charger into the socket to start the charging process.

Fig.5-14

The display shows the charging mode during this time.

However, another USB cable (e.g. from a laptop) can also be used. The charging time is 2-3 hours. The following figure shows the end of the charging time:

7 The endurance test

7.1 Check preset

It is switched on with the key and checked whether charging is necessary. Then it is checked whether each presetting is also correct, especially the type of material and the hardness scale. If the preset parameters do not match the current conditions, measuring errors are very likely.

7.2 Preparation of the test piece

Unsuitable material samples can cause measuring errors. Therefore preparation and processing should be carried out under the original conditions of the sample. The preparation of the sample and its surface should meet these basic requirements:
1) During surface preparation of the sample, the rebound sensors should not be exposed to thermal cooling or heating.
2) The surface should be even or better still have a metallic shine, there should be no oxide layers or other dirt on it.
3) The roughness of the surface should be Ra≤ 1.6
4) The material sample should be of sufficient quality and hardness. If this is not the case, larger measuring errors may result (e.g. due to shaking of the rebound sensor when it is placed on the material, etc.).

The basic rule is:
If the weight of the sample material is more than 5 kg, testing can be carried out directly.
If the weight is 2 to 5 kg, the material should be clamped with suitable means.
With a weight of 0.05 to 2 kg, the sample should be coupled in advance with a heavier object. Coupling method: The back side is smoothed, a little coupling agent (industrial vaseline can be used) is applied to the support and the surface of the support is pressed onto the underside of the material sample. The total weight should now exceed 5 kg. It can also be replaced by the test block.
If the weight of the sample material is less than
0.05 kg, the hardness tester is not suitable for use with this.
5) The samples should have a sufficient material thickness with a suitable surface.
For the rebound sensor type D the material thickness is at least 5mm and the surface hardness coating should not be less than 0.8mm. To determine the exact hardness of the material, it is best to remove the surface coating.
6) If the material surface to be tested is not horizontal, the radius of curvature of the surface should be greater than
30 mm. A suitable stabilizing ring should be selected and attached to the rebound sensor.
7) The test material must not be magnetic. The signal of the rebound sensor would be seriously affected by the magnetism and the result would be inaccurate measurement results.
Modern electronics with energy-saving features ensure the long service life of the HN-D. The large LCD display always shows the configuration of the instrument for testing. Variable function keys allow a quick change of the general influencing variables.
Further tests can be performed by repeating the above steps. Subjective measurement errors are excluded and the measurement results are highly reproducible. Internal self-diagnostics with error messages ensure a reliable measurement result.
Reading values can be automatically stored in the memory of the device or sent directly to the printer. The PC evaluation software enables data analysis.

8 Problems and finding solutions

No.	Problem	Reasons	Solutions
1	cannot be switched on	No power	Charging the batteries
2	Extremely high measurement results	Test tip is worn out	Replace test probe
3	No measurement results	Damage of the coil	SAUTER Company contact

Please contact SAUTER GmbH in the event of other errors or defects.
We will look for a solution to your existing problem with the HN-D as soon as possible.

9 Service and maintenance

9.1 Maintenance and care of the rebound sensor

After using the rebound sensor 1000 to 2000 times, the cannula should be cleaned with a nylon brush. First the screw and the stabilizing ring are removed. The nylon brush is turned counterclockwise in the loading tube until the lower end of the tube is reached. Then the nylon brush is carefully pulled out again. This procedure is repeated several times. Afterwards the rebound body with the stabilizing ring is reattached. After each use, the rebounding body should be unlocked (released) again. Please do not use lubricant!

9.2 Procedures for maintenance

If the error value during calibration of the hardness tester is more than 12 HLD, the steel ball or rebound body should be replaced, as these can be worn out and this can lead to malfunctions during use. If any other abnormal phenomena occur with the tester, never unscrew or modify any of the fixed parts yourself. We should be contacted in advance and the device should be sent to us so that the service can be carried out.

Appendix 1 Daily checking

The optionally available test block is generally used to calibrate the hardness tester. The measurement deviation and reproducibility of the hardness tester HN-D should be in the range of the following table:

Rebound sensor	Alignment Rebound-sensor	Hardness of the Test Blocks (HL)	permitted Messab-softness	permitted Again-holbark.
D	↓	750~830	±12 HLD	12 HLD
		490~570	±12 HLD	12 HLD

Note:

1. Error=$\overline{HLD}$-HLD

HLD is the average of 5 values measured on the test block.
The HLD value is signed on the test block.

2. repeatability= $HLD_{max}-HLD_{min}$

HLD_{max} ***is the highest value of 5 values measured on the test block.***

HLD_{min} ***is the smallest of 5 values measured on the test block.***

Appendix 2 Factors influencing the measurement accuracy

Incorrect operation or inappropriate conditions can have serious consequences for the accuracy of measurement in the tests. Below are some examples:

1. The roughness of the surface of the test piece

When the rebound body hits the test piece, a small impression is made on its surface. The rougher this surface is, the less loss of rebound energy. If the surface is less rough, the more loss of rebound energy is observed.
The roughness of the test points of the test piece on the surface should be Ra≤ 1.6.

2. The profile of the surface of the test piece

The Leeb test principle is based on the fact that the velocity of impact and rebound occur in the same line because the rebound body moves back and forth in the metal tube. If the radius of curvature of the surface to be tested is smaller, different support rings can be used. These are available in addition to the scope of delivery.

3. The weight of the test piece

Ideally, the weight of the test piece should be 5 kg or more. If it is less than 5 kg, it must be weighted. This is done by connecting the test piece to a supporting, additional attachment using a coupling device to achieve the required weight. This allows more accurate measurement results to be obtained. There should be a specific area for the test points on each test piece, which is free of shock and vibration. If the test piece is not sufficiently heavy, all the more care should be taken to avoid fluctuations and vibrations, especially if the test piece has been weighted, coupled and compressed.

4. The measurement stability of the material sample

In any test, external interference should be kept to a minimum. This is very important for dynamic measurements like Leeb hardness tests. Therefore measurements are only possible in a stable Leeb hardness test setup. If it is foreseeable that the test piece will change position during the test, it should be fixed in advance.

Annex 3 Measuring range and conversion range

Materials	AGM	HB	HRC	HRB	HSD
Steel & cast steel	81-955	81-654	20.0-68.4	38.4-99.5	32.5-99.5
Tool Steel Alloy	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 cast iron		140-387			
Aluminium casting alloy		19-164		23.8-84.6	
Cu-Zn alloy (brass)		40-173		13.5-95.3	
Cu-Sn alloy (bronze)		60-290			
Copper		45-315			
Forged steel	83-976	142-651	19.8-68.5	59.6-99.6	26.4-99.5

DEVELOPED IN ACCORDANCE WITH 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).

Note:
To view the CE declaration, please click on the following link:
https://www.kern-sohn.com/shop/de/DOWNLOADS/