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OPERATION MANUAL

**Model ISH-PHA
PORTABLE HARDNESS TESTER**



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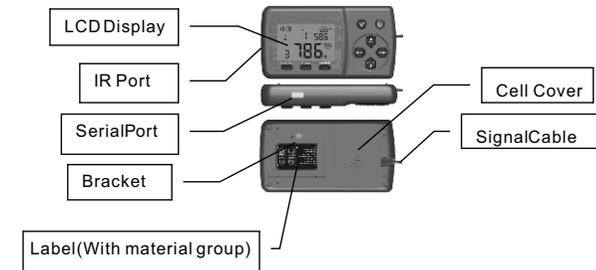
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1. Technical Specification

- Display range: 0~999HLD
- Accuracy: ±6 HL(at 800HLD)
- LCD: large LCD with backlight
- Resolution: 1HL; 1HV; 1HB; 0.1HRC; 0.1HRB; 1HSD; 1MPa
- Power: dry cell (3 ×1.5V AAA)
- Operating temperature: 0°C to +50°C (32°F to 122°F)
- Storage temperature: -10°C to +60°C (14°F to 140°F)
- Humidity: 90 % max.
- Dimensions: 150mm×80mm×24mm (5.9 × 3.1 × 0.9")
- Weight: 200g

2. Parts Description

2.1 Overview the display unit



2.2 Impact device



- 1. Impact body 2. Support ring 3. Coil 4. Cable
- 5. Catch chuck 6. Loading tube 7. Release button

3. Quick Start Guide

3.1 Connect

Connect the signal cable to the impact device.

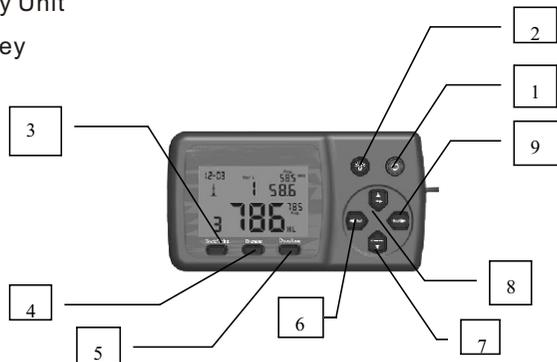
3.2 Calibration

Test block are calibrated in accordance with the dynamic hardness value HL in order to making sure the hardness tester work well. You must be calibrated it on the test block before using the hardness tester for the first time. (Appendix 1)

4. Operating Instructions

4.1 Display Unit

4.1.1 Key

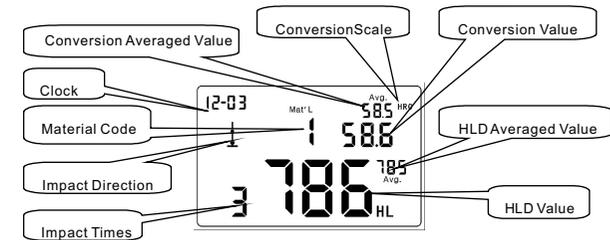


1. “⏻” On/Off button: turn it on by pressing and holding “⏻” button, If the display unit is on, turn it off by pressing and holding “⏻” button.
2. “☀️” Backlight button: Press “☀️” button to turn on the LCD backlight; Press again to turn off the LCD backlight.
3. “Back/Print” button:
 - ① In measurement mode, press and hold “Back/Print” button to erase the measured data, at the same time, if the mini-printer is linked with the display unit, it will print out those data.

- ② In other mode, press “Back/Print” button to complete setup and save the parameters that you set and return to the measurement mode.
4. “Browse” button: Browse the memory data.
5. “Date/Time” button: adjust the clock and calendar.
6. “←” button: press and hold “←” button to delete current data in measurement mode or browse mode.
7. “↓” button: press “↓” button to setup the conversion scale in measurement mode. In Date/Time setup mode and calibration mode, press “↓” button to decrease the flickering bit. In browse mode, press “↓” button to display the next data.
8. “↑” button: press “↑” button to setup the impact direction in measurement mode. In Date/Time setup mode and calibration mode, press “↑” button to increase the flickering bit. In browse mode, press “↑” button to display the previous data.
9. “↔️” button: in measurement mode, press “↔️” button to select the material that you will impact. In Date/Time setup mode and calibration mode, press “↔️” button to select the next bit.

4.1.2 Measurement Mode

ISH-PHA Hardness Tester has a large LCD and display abundance of information.



4.1.3 Setup

4.1.3.1 Material Group

In measurement mode, press “↔️” button to select the material you will impact. The material list is on the back label.

| Hardness | Tensile strength (MPa) |
|--------------------------|------------------------|
| 01. Steel and Cast Steel | 11. Low Carbon Steel |
| 02. Alloy Tool Steel | 12. Hi Carbon Steel |
| 03. Stainless Steel | 13. Chrome Steel |
| 04. Grey Cast Iron | 14. Cr-V Steel |
| 05. Ductile Iron | 15. Cr-Ni Steel |
| 06. Cast Al Alloys | 16. Cr-Mo Steel |
| 07. Cu-Zn Alloys | 17. Cr-Ni-Mo Steel |
| 08. Cu-Sn Alloys | 18. Cr-Mn-Si Steel |
| 09. Copper | 19. Hi Strength Steel |
| 10. Forging Steel | 20. Stainless Steel |

Press “

Note:

1. It is necessary to select the material classification. When you did not know the material type, you must be reference the related material handbook.
2. When you change the material group, the impact times counter will be set to “0”.
3. Default setting: steel and cast steel.

4.1.3.2 Impact Direction

Ideal Leeb Hardness Testing is a downward straight testing method. As a result of gravity, the test should be amended when measuring other directions in order to measuring correct hardness value of material. As long as you correctly choose the impact direction, ISH-PHA Hardness Tester can automatically be amended.

There are five impact directions to choose: , , , , 

Note: Default Setting: 

4.1.3.3 Scale

ISH-PHA Hardness Tester can automatically convert HLD values to other hardness scales HRC, HRB, HB, HV, HSD or tensile strength (MPa) according to a particular material group (e.g. steel, aluminium etc.)

In measurement mode, press “

Notes:

1. The conversion value is “---” indicated the conversion is out of range.
2. When you set the conversion from hardness scale to tensile strength or from tensile strength to hardness scale, you must be reset the material group.
3. Conversion value only supplies the general reference, which may result in some offset. Precisely conversion generally needs related comparative tests.
4. When you change the hardness scales, the current impact time's counter of measuring interface will be clear to “0”.
5. Default setting for the conversion is “HRC”.

4.1.3.4 Browse

Press “Browse” button to browse stored data and display the first data group in last nine test data, including hardness value HLD, material, conversion values, impact direction, date and time etc.

Press “

4.1.3.5 Adjust the clock and the calendar

ISH-PHA Hardness Tester has built-in real-time clock system.

It must be adjusted the clock and the calendar when you reinstall the dry cell or other necessary case. Please as follows:

Press “Date/Time” button to the clock and the calendar adjustment mode, and the “month” bit will be flicker, press “

Then press “

6

Then press “

4.1.3.6 Calibration

Calibration is used to calibrate the measured value (HLD) of the hardness tester, so as to farthest decrease the measuring error, please as follows:

- 1) Press “Back/Print” button to clear testing times to “0”, impact five times in test blocks to obtain the average value (can delete some error data in operation).
- 2) Press and hold “Date/Time” button about 2 seconds to display the calibration mode, input the HLD value that marked on test block through the “

Note: You must be calibrated it on the test block before you first using the hardness tester.

The default impact direction is  (Appendix 1)

4.2 The Format of Memory Data

The data group (such as test result, conversion result, sample material and impact direction) automatically save in memory after one individual measurement. ISH-PHA hardness tester can store nine sets of data, when measuring times more than nine, the last group of data will store the 9th position and the

first group of data will be erased. The second group of data will be moved into the 2th position, simultaneously the position of other group of data, will be moved into lower position.

Press and hold “Back/Print” button to end the measurement and print out the memory data (when connected to printer) in test. Completing print, the original data will be erased automatically.

4.3 Backlight

Highlight LED backlight is used for poor light conditions. Users can turn on or turn off the backlight by pressing “

4.4 System Reset

If the display unit isn't working properly or halt, users can press the “Reset” button by insert a slender rod into the reset hole at the backside of display unit, and then the display unit will be shutdown. Press and hold “

4.5 Automatic Shutdown

If there is no measure, and no key operation in 3 minutes, display unit will automatically switch off in order to saving battery power. Display unit will automatically store all the parameters before turning-off.

5. Data Print

ISH-PHA Hardness Tester can be linked with micro printer, so the printer can print out hardness test result report.

5.1 Printer Link

Display unit and printers using infrared connection (or cable connection): move the printer to the left side of display unit and let the printer infrared window be opposite with the display unit infrared windows. Turn on the micro printer and display unit, then press “Back/Print” button; it can print out the test report.

5.2 Test Report Format

Below figure shows an complete test report format.
 Note: the date and time printed is the report end date and time.

```

-----
                    Test Report
-----
Impact Unit Type: D
Material : Steel&Caststeel
1  808 HLD  ↓  61.2 HRC
Date: 30-12-08  Time: 18:21:27
2  808 HLD  ↓  61.2 HRC
Date: 30-12-08  Time: 18:21:27
3  805 HLD  ↓  60.8 HRC
Date: 30-12-08  Time: 18:21:27
4  808 HLD  ↓  61.2 HRC
Date: 30-12-08  Time: 18:21:27
5  805 HLD  ↓  60.8 HRC
Date: 30-12-08  Time: 18:21:27
-----
s = 3  HLD  00.4 HRC
x̄ = 806 HLD  61.0 HRC
Printed: 30-12-08  18:21:27
-----
    
```

6. Hardness Test

6.1 Test Preparation

- 1) Make sure if system connection is safe and reliable.
- 2) Press “

6.2 Sample Preparation

Inappropriate sample will cause a great measurement error. Therefore, users should make the necessary handling and preparation under the original conditions of sample.

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

- 1) During the process of sample surface preparation, users should avoid the impacts of cold processing and thermal processing.
- 2) The sample surface is plane for better, the test surface should be with a metallic sheen, and not involve oxide layer or

other stains.

3) Roughness of the test surface $Ra \leq 1.6$

4) Sample must be of sufficient quality and rigidity. If it's lack of quality and rigidity, it may cause displacement or shaking in the process of testing impact, which can lead to large errors.

Generally speaking, if the sample quality is more than 5kg can be directly tested; if the sample quality is 2~5kgs, the sample should be taken in fixation test by means of appropriate clamping; if the sample quality is 0.05~2kgs, the sample should be conducted coupling before the test; if the sample quality is less than 0.05kg, this hardness tester is inappropriate to use.

Coupling method: Testing sample's back should be prepared to make a plane as a supporting surface with a smooth formation. Filling with a little coupling substance (Industry Vaseline can be used), users can now press to the surface of the supporting object (The weight of supporting object should be more than 5 kg, and it can be replaced by test block) to stick into integration.

5) Samples should be thick enough and with sufficient surface absorption layered. If users use D-type impact device, the thickness of sample should not be less than 5mm, and surface absorption layer (or surface-hardening layer) should not be less than 0.8mm. To accurately measure the hardness of the material, the best way is to remove the surface-hardening layer by processing.

6) When testing sample surface is not horizontal, the curvature radius of testing and nearby surface should be larger than 30mm. And appropriate supporting ring should be elected and installed.

7) A sample should not be with magnetic. The signal of the impact device would be seriously interfered in the work by the magnetic, which may cause inaccurate test results.

6.3 Test Steps

1) Loading

Simply load the impact device by sliding the loading tube forward.

2) Place

Then place and hold the impact device on the surface of the test piece at the desired test point. Impact indirection should

be vertical with the test of surface.

3) Burst impact (Measure)

Trigger the impact by pressing the release button. The hardness value will be instantaneously displayed.

4) Read off the test result

Read off the test result from LCD at figure 6-1.

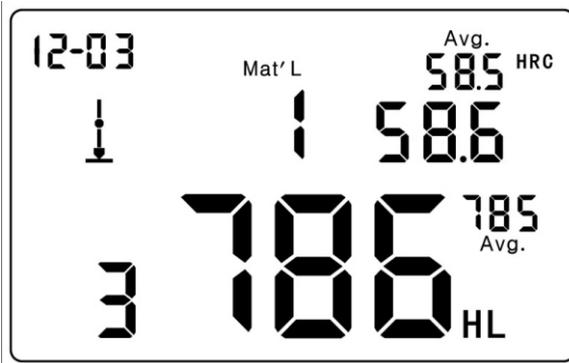


Fig.6-1

Sample material: steel and cast iron;

Impact direction: downwards;

Date: 3rd, Dec;

The current hardness value: 786HLD;

The current measurement is the third point;

The current mean value: 785HLD

Conversions to HRC: 58.6HRC

The mean value of HRC: 58.5HRC

Repeating the above steps, users can carry out tests in more points.

Note: Generally, each measurement location of sample is conducted for the five tests. The "S" (difference of maximum value and minimum value) values must be less than 15HL. The distance between any two impact position should be ≥ 3 mm ; the distance between impact position and the edge of the sample should be ≥ 3 mm.

7. Maintenance

7.1 Impact Device Maintenance

After using 1000-2000 times, users should clean the catheter of impact device and impact body with nylon brush, and screw off the supporting ring before clean the catheter, and then take out the impact body, rotate the nylon brush into the tube in an anti-clockwise direction, and pull out when touching the bottom. So repeatedly, and then load up the impact body and supporting ring; Users should release the impact body after use. And the lubricant is banned.

7.2 Normal Maintenance Procedures

In calibration of the hardness tester, if finding that error is larger than 12HLD, users must be renew the steel ball or impact body, because the reason may be that the steel ball or impact body is wore out to lead to failure in operation.

Appendix 1 Daily Checking

Normal test block is mainly used for calibrate the hardness tester. The error and the repeatability of the hardness tester should be in the scope defined by the 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= \overline{HLD} -HLD

\overline{HLD} is the average value of 5 values measured on the test block.

HLD is the value that marked on test block.

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

HLD_{max} is the maximum value in 5 values that measured on the test block.

HLD_{min} is the minimum value in 5 value measured on the test block.

Appendix 2 Factors Affection Accuracy

Incorrect operation or improper testing conditions would have serious impact on testing accuracy. Following is several common factors effect the accuracy of testing for the use of reference:

1) Roughness of sample surface

When the impact body impact on the sample, a small pit would arise on the sample surface, so at the same time, should finish the surface of the sample. The more roughness, the less consumption of impact energy whereas the less roughness, the more consumption of impact energy. Accordingly, the roughness of sample testing points on the surface $Ra \leq 1.6$.

2) The shape of sample surface

Leeb testing principle demands the velocity of rebound and impact are on the same line, because the impact body is moving in a metal tube. Even if the velocity of rebound and impact are not on the same line, it also can show hardness for sure, but the impact body would collide with tube wall when it rebounds, which will affect the velocity of rebound. Therefore, a greater error is on test accuracy. When the radius of curvature of the testing sample surface is smaller, the solution is the use of suitable variant supporting circle. If users require special supporting circle, we can contribute to design and process.

3) The weight of the sample

If the sample weight must be larger than or equal to 5kg, and not easily sway. If the sample weight were less, the sample would need proper treatment (It is necessary to increase the supporting or mounting through coupling compress on larger weight testing stand), and the testing results can be achieved in accuracy. There should be a certain area at the testing points (the area required to meet a set of testing points) and no vibration or shaking. If the weight is not enough, users must be as much as possible reduce the jitter and sloshing by the methods of increasing supporting, coupling and compressing. And supporting device should avoid shock.

4) The sample stability

Any effective tests need to minimize possible interference from outside; it's more important to dynamic measure such as Leeb hardness test. Therefore, measuring only allowed in stable hardness testing system. If it's likely to lead to sample movement in the tests, users should fix it before testing.

Appendix 3 Measuring And Conversion Range

| Materials | HV | HB | HRC | HRB | HSD | Tensile strength(Mpa) |
|---------------------|--------|---------|-----------|-----------|-----------|-----------------------|
| Steel & cast steel | 83-976 | 140-651 | 19.8-68.5 | 59.6-99.6 | 26.4-99.5 | 375-2639 |
| Tool steel | 80-900 | | 21-67 | | | |
| Stainless steel | 85-802 | 85-655 | 20-62 | 47-102 | | |
| Cast iron | | 140-387 | | | | |
| Cast aluminum alloy | | 30-159 | | | | |
| Brass | | 40-173 | | 13.5-95.3 | | |
| Bronze | | 60-290 | | | | |
| Copper | | 45-315 | | | | |

Appendix 4 Material Code

| Code | Material | Code | Material |
|------|--------------------|------|-------------------|
| 01 | Steel & Cast Steel | 11 | Low Carbon Steel |
| 02 | Alloy Tool Steel | 12 | Hi Carbon Steel |
| 03 | Stainless Steel | 13 | Chrome Steel |
| 04 | Grey Cast Iron | 14 | Cr-V Steel |
| 05 | Ductile Iron | 15 | Cr-Ni Steel |
| 06 | Cast Al Alloys | 16 | Cr-Mo Steel |
| 07 | Cu-Zn Alloys | 17 | Cr-Ni-Mo Steel |
| 08 | Cu-Sn Alloys | 18 | Cr-Mn-Mo Steel |
| 09 | Copper | 19 | Cr-Mn-Si Steel |
| 10 | Forging Steel | 20 | Hi Strength Steel |