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## **OPERATION MANUAL**

**Model ISH-SPHA  
PORTABLE HARDNESS TESTER**



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## 1. Technical Specification

- Display range: 0~999HLD
- Accuracy: ±6 HL(at 800HLD)
- LCD: large LCD with touch screen
- Resolution: 1HL; 1HV; 1HB; 0.1HRC; 0.1HRB; 1HSD; 1MPa
- Power: Rechargeable Li-ion batteries
- 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: 135mm×83mm×24mm (5.3 × 3.2 × 0.9")
- Weight: 230g

## 2. Parts Description

### 2.1 Overview the display unit



1. Sensor jack 2. LCD screen 3. Printer and charger jack  
4. Reset hole 5. IRDA window

### 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

use the signal cable to connect between impact device and sensor

#### 3.2 Charge the Battery

You must charge the battery fully (in display unit) before using the instrument for the first time.


#### 3.3 Calibrated the Instrument

Test block are calibrated in accordance with the dynamic hardness value L. You must be calibrated the hardness tester by the test block before using the hardness tester for the first time.

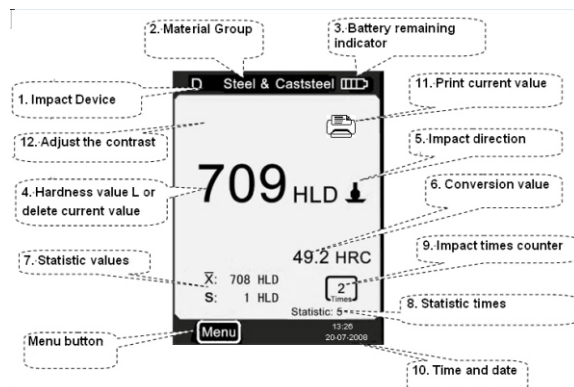
### 4. Operating Instructions

#### 4.1 Display Unit

##### 4.1.1 Keyboard

POWER ON/OFF button : Press it to turn on the hardness tester; Press this button again for one second to turn off the instrument.

##### 4.1.2 Measurement Mode



1. Impact Device: The impact unit type that connected to the display unit, you can click this icon to change the type of impact unit.
2. Material group: The material group of the sample.
3. Battery remaining indicator: indicate the remaining time of battery.
4. Hardness value L: Measured hardness value L. (Users can click this area to delete current measuring date.)
5. Impact direction: Display the impact direction.
6. Conversion value: The conversion value of measured value "L".

**Note:**

1. When "---" appear at this position, indicated the conversion is out of range.
2. When no message at this position, Indicated that the "Conversion" have be set to "do not conversion" in this time.
7. Statistic values:
  - X: Mean value.
  - S: The difference of maximum value and the minimum value (Measured hardness value L).
8. Statistic times : The impact times in a statistic data group
9. Impact times counter: Finished times of impact
10. Time and date: time and date of the system
11. Print current date: Print current date
12. Adjust the contrast of LCD

#### 4.1.3 Adjusting the LCD Contrast Manually

Due to the use of different ambient temperatures and light conditions, it requires to adjust the contrast of LCD in order to making for observing and reading data.

Click "12" area can open dialog box which adjusts the contrast of LCD.

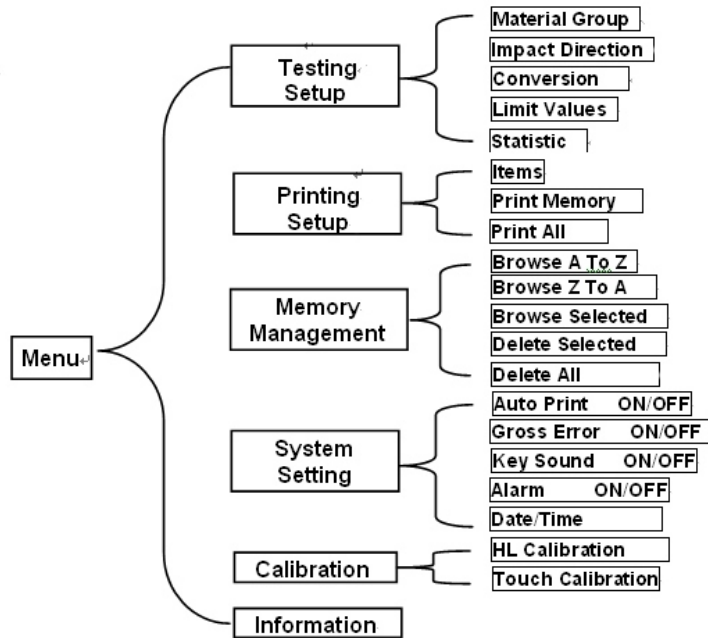
To click directly the following instruction of "Contrast Adjustment" can adjust the contrast of LCD on touch screen.

After the contrast adjustment to the appropriate state, sers click "12" area to confirm contrast and close this dialog box.

If there is no an operation in 3 seconds when open the dialog box which adjust the contrast of LCD, this dialog box will close automatically.

After adjusting contrast, the contrast will be restored to its original state if users will not click "A" area again to confirm the current operation.

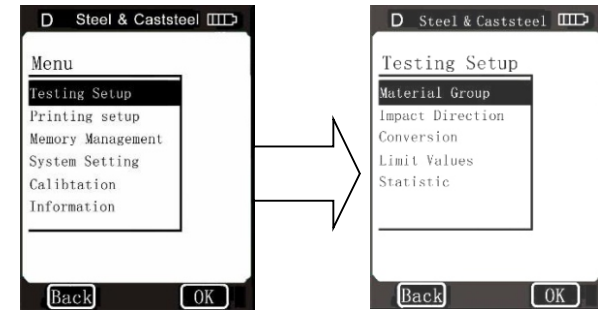
#### 4.2 Menu



##### 4.2.1 Testing Setup

Click Testing Setup item on the menu mode to display the Testing Setup menu.

This menu item contain five selectale items: Material Group, Impact Direction, Conversion, Limit Values and Statistic.



Menu mode

Testing setup menu

##### 4.2.2 Printing Setup

You can print out the measured values in many formats. In menu mode, directly click Printing Setup on the menu mode to display the Printing Setup menu.

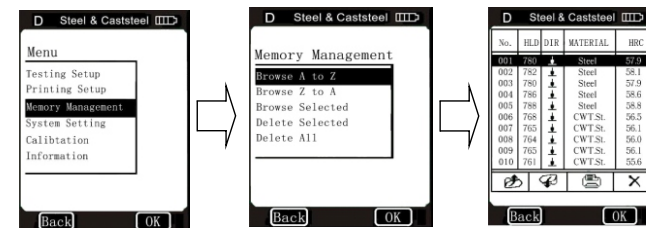
There are three options in this menu: Items, Print Memory and Print All.

##### 4.2.3 Memory Management

Through this menu, you can browse and delete the memory data, simultaneously also can print out the memory data.

In menu mode, directly click Memory Management item to display the Memory Management menu.

There are five options in this menu: Browse A To Z, Browse Z To A, Browse Selected, Delete Selected and Delete All.



Menu mode

Memory management menu

Browse A To Z

##### 4.2.4 System Setting

System Setting contains some system function switches; users can setup various switching functions according to their

requirements, such as the adjustment of system calendar and clock.

In menu mode, directly click the System Setting option on the screen to display system setting menu, users can set for the corresponding switches or turn into the windows of setting system calendar and clock. Clicking BACK, users can turn back to the upper menu.

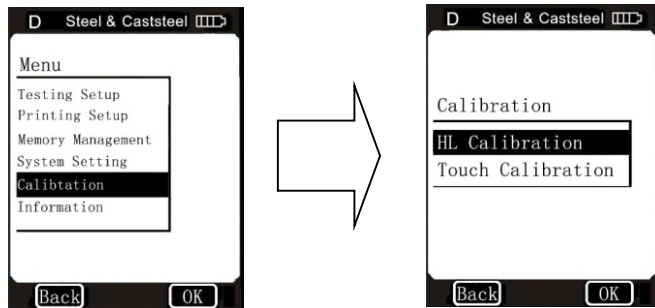
4.2.5 Calibration

The Calibration contains the HL Calibration and Touch Calibration.

HL Calibration is used to calibrate the measured value (HL) of the hardness tester, so as to farthest decrease measuring error.

The Touch Calibration is used to calibrate the accuracy of the touch screen position, so as to provide correct fast operation of touch screen.

In System setting menu, select Calibration by clicking on the Calibration option to enter the Calibration screen.

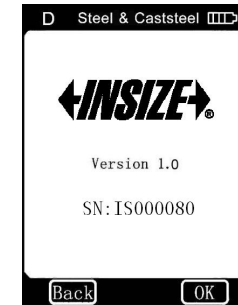


4.2.6 Information

Information includes developers and version information of the software and the serial number of the unit. Products manufactured in different periods, the software will be different because of version upgrade. Therefore in use, if users ask service engineer or agent for advice of technical problems related to software, they may be required to provide such information.

In menu mode, users can directly click Information on the screen to get in the window of Information.

Note: Version number may be changed with software upgrade, which will not be re-notified.



4.3 Charging

Users need to recharge batteries when batteries are used for the first time and exhaustion of electricity arises.

The capacity of battery will show as empty after exhausting use (3 columns as full), and show a word "Power Shortage!" Besides, the buzzer will beep once in two seconds to tell the user it's time to charge.

Firstly, users should insert the USB plugs of charger into the right USB jack of display unit and then connect the charger with AC socket (220V/50Hz) to start charging. Meanwhile, the screen of display unit will display "charging...".

When instrument is at the turn-off model, charging instrument will be automatically switched on, and the battery symbols will be shown consecutively.

At the end of charging, users can see "charging complete" on the screen. If users press ON/OFF button at this time, the instrument won't be turned off, because it is on a supervision mode.

Note: Please use the exclusive charger for the display unit.

4.4 Backlight

Users need to recharge batteries when batteries are used for

poor light conditions. It can automatically open backlight when turn on the instrument. If there is no measure, and no touch screen operation, instrument will close backlight itself for saving power. It won't reboot until the status above happens. If the backlight is off, when users click touch screen or have measurement, then the backlight will light up again.

#### 4.5 Reset

If the display unit isn't in order or halt during the use process, users can click the reset button by insert a slender rod into the Reset hole at the right side of display unit, and then the instrument will restart.

#### 4.6 Automatic Shutdown

Display unit will automatically shutdown in the following case in order to save battery power. Display unit will store all the parameters automatically before turning-off.

1. If there is no measure, and no touch operation in 3 minutes, display unit will automatically switch off. And it will beep continuously in 10 seconds before shutdown.
2. When battery power is not enough, the display unit will display "power shortage", and buzzer will beep once in one second, and the display unit will automatically switch off after 10 seconds.

### 5. Data Printer

ISH-SPHA Hardness Tester can be linked with exclusive micro printer, so printer can print out the measured values.

#### 5.1 Printer Link

Switching off the power of the display unit, users can then insert the USB plugs of printer cable (optional) into the USB jack for printer at the right side of display unit, and insert the other side of cable into the socket at the left side of printer, connecting the printer with display unit. Users can now boot the printer by pressing POWER button on the printer, and turn on the display unit next.

#### 5.2 Infrared Printing

Put the display unit's infrared launch window at the level of printer's in infrared receive window. At this time, users can use infrared print like serial print.

**Note:** When using serial cable to print, users cannot put the hardness tester's infrared launch window at the level of printer's infrared receive window; similarly, when using infrared print, users should pull down the serial cable. Otherwise, the printer will print unrecognizable code; even the paper will be non-stop output from printer.

#### 5.3 Test Report Format

```

-----
                        Test Report
-----
Impact Unit Type: D
Material : Steel&Caststeel
1  809 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  809 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
-----
    
```

#### 5.4 Test Report Printing

ISH-SPHA Hardness Tester offers various typing ways. Users can flexibly choose the way of typing in the actual use.


##### 5.4.1 Automatic Printing

If Auto Print has been set to ON, printer can print automatically during the measure process. Display unit will sent out the data to printer after the completion of a group of test data. The printer will print the title of report before the beginning of each group of data. When the Statistic Times Values is set as 1, the printer can't print automatically. When the Statistic Times Values is set as 2 to 99, the printer will print automatically by the statistic group.

#### 5.4.2 Manual Printing


When Auto Print has been set to OFF, users can operate printer manually. And manual printing can be divided in two types.



##### 1. Statistic Times Values is set as 1

After every time of impact, the uses can print out the measured value by clicking the  on the measure mode.

The printer will automatically print the information in the title part when printing starts.

##### 2. Statistic Times Values is set as 2 to 99

When the impact times is up to users Statistic Times Values, click the , the printer will print out all the measured values and statistics results in the group, and form a complete test report.

If users click the  before the impact times up to the Statistic Times Values, the printer will print out all the finished test values. When the impact times is up to users Statistic Times Values, users can click  again to print out the rest data and statistics results, by then, report printing completed.

## 6. Hardness Test

### 6.1 Test Preparation

- 1) Make sure if system connection is safe and reliable.
- 2) Press ON/OFF button to switch on the power, inspect if every setting of display unit is correct, particularly the materials type and impact direction. The setting inconsistent with the actual condition may set up a great error.

### 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

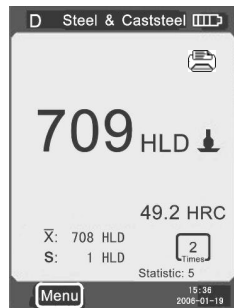
Then place and hold the impact device on the surface of the test piece at the desired test point. Impact indirection should

be vertical with the test of surface.

3) Measure

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

4) Read the test result. Modern electronics with power saving features provide for long operating life. The large LCD display always shows how ISH-SPHA hardness tester is configured to test. Variable function touch screen allow for quick change of common test parameters, and the on screen hint line shows the other active control keys. 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 sent directly to a printer. Repeating the above steps, users can carry out tests in more points.



**Step 4**

## 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