

# Digital Rockwell Hardness Tester Instruction Manual

iqualitrol

## Notes

1 Before using this instrument, you should read the "Instruction Manual" carefully to learn more about the operation steps of the instrument.

Avoid instrument damage or safety accidents due to improper use.

2 Please remove the tape and shockproof tape carefully when the instrument is installed and debugged.

3 The power outlet of the instrument must be single-phase three-core socket, the grounding end must meet the prescribed protection grounding requirements.

4 The installation position of the electrical components, switches and sockets of the instrument is strictly forbidden to disassemble and assemble by itself. If disassembled without authorization, it may cause accidents.

5 In the process of applying or removing the test force and the test force, the instrument shall not rotate the variable load hand wheel or the rotating wheel.

6 This unit is committed to improving the quality of the hardness tester and constantly updating the structure. If the user manual

The content described is slightly different from the structure of the instrument, and will not be notified, please forgive me.

# Contents

<b>1 .Introduction.....</b>	<b>3</b>
<b>2 .Technical parameters of the hardness tester.....</b>	<b>4</b>
<b>3 .Hardness tester installation.....</b>	<b>5</b>
<b>4 .Panel key function introduction.....</b>	<b>7</b>
<b>5 . Correct use of hardness tester.....</b>	<b>8</b>
<b>6 . RS-232 hyper terminal settings.....</b>	<b>10</b>
<b>7 . Maintenance and precautions of hardness tester.....</b>	<b>10</b>
<b>8 . Accessories (packing list).....</b>	<b>13</b>
<b>9. Warranty Card.....</b>	<b>14</b>

## I. Introduction

### 1 hardness

#### 1.1 Definition and Application of Hardness tester

The so-called hardness is the ability of a material to resist being pressed by another object without residual deformation under certain conditions. The greater the resistance, the higher the hardness, and vice versa, the lower the hardness. Hardness tester is a test instrument used to determine the hardness of materials, and hardness test is a means to judge the quality of metal materials or product parts.

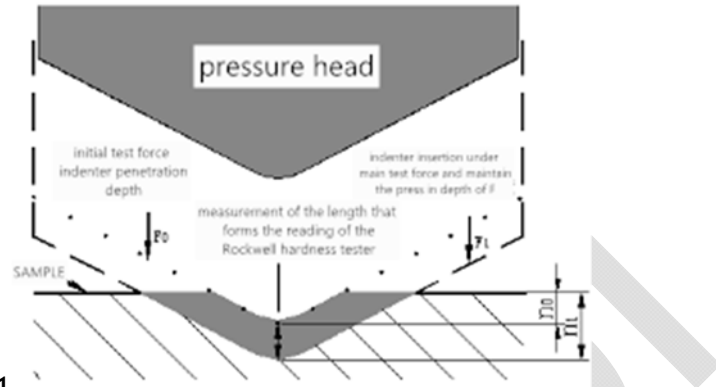
This instrument is mainly suitable for Rockwell hardness test of materials.

In the mechanical performance test, measuring the hardness is the easiest, most economical, and fastest method, and it is also one of the measures to check the product quality in the mechanical manufacturing process. Since the hardness of metal has a corresponding relationship with other mechanical properties, most metal materials can approximate other mechanical properties such as strength, fatigue, creep, wear and internal damage by measuring the hardness.

#### 1.2 Basic principles of Rockwell hardness test:

At the beginning of the test, the indenter of the testing machine is placed on the test piece, the initial test force is applied, and a reference point measured by the displacement measuring device is established. Because the initial test force presses the indenter into the test piece, the smoothness or irregularity of the surface will not affect the test. Then the testing machine applies the main test force, this larger force penetrates the sample deeper, and then removes the main test force while maintaining the initial test force. At this time, the testing machine measures the

depth of the dent relative to the established reference point. The linear depth of the dent is the basis of the Rockwell hardness value. A shallow dent depth only means that the material is harder, and a relatively deep dent depth means that the material



is softer. As shown in Figure 1-1

Figure 1-1 Measuring principle diagram of hardness tester

### 1.3 Rockwell hardness test formula:

$$\text{HRC.A} = 100 - n1 - n0 \quad 0.002 \quad (1.1)$$

$$\text{HRB} = 130 - n1 - n0 \quad 0.002 \quad (1.2)$$

Where:  $n0$  — the depth of the indenter into the sample under the action of the initial test force  $F0$

$n1$  — The depth of the indenter into the specimen when the total test force  $F$  is applied and the main test force  $F1$  is removed, but the initial test force  $F0$  is still maintained.

### 1.4 Numerical representation of hardness tester

According to relevant standards, the hardness is expressed as: hardness value + hardness scale + others: such as hardness: 60HRC, etc., please refer to the relevant standards for details.

2 The digital Rockwell hardness tester has a novel large screen display, which has good reliability, operability and intuitiveness

Its main functions are as follows:

2.1 Choice of Rockwell hardness scale

2.2 Selection of plastic Rockwell scales (special requirements, supplied by contract)

2.3 Hardness conversion between each hardness;

2.4 Hardness test results are printed out;

2.5 RS-232 Hyper terminal settings for users to expand functions.

### **Technical parameters of a secondary hardness meter**

1 Initial test force: 10kgf (98.07N) tolerance  $\pm 2.0\%$

2 Total test force: 60kgf (588.4N), 100kgf (980.7N), 150kgf (1471N), tolerance  $\pm 1.0\%$

3 Indenter specifications:

3.1 Diamond Rockwell indenter

3.2  $\varphi 1.5875\text{mm}$  ball indenter

4 voltage: 220V

5 dwell time: 1-60 seconds adjustable

6 Maximum allowable height of the tested piece: 230mm

7 Distance from center of indenter to body: 165mm

8 Dimensions of the hardness tester (length $\times$ width $\times$ height) 520 $\times$ 240 $\times$ 720 (mm)

9 Approximate weight of the instrument: 85kg

10 Rockwell Hardness test scale, indenter, test force and application range (Table 1)

**Table 1**

Ruler	Indenter type	Initial test force	Total test force (N)	Scope of application
HRA	Diamond indenter	98.07 N (10kg)	588.4(60kg)	Hard alloy, carbide surface hardened steel, hardened thin steel plate
HRD			980.7(100kg)	Thin steel plate, surface hardened steel
HRC			1471(150kg)	Hardened steel, quenched and tempered steel, chilled cast iron
HRF	Ball indenter $\varphi$ 1.5875m m (1/16 inch)		588.4(60kg)	Cast iron, aluminum, magnesium alloy, bearing alloy, annealed copper alloy, thin soft steel plate, etc.
HRB			980.7(100kg)	Mild steel, aluminum alloy, copper alloy, malleable cast iron, annealed steel

HRG			1471(150kg)	Phosphor bronze, beryllium bronze and malleable cast iron
HRH	Ball indenter $\varphi$ 3.175mm (1/8 inch)		588.4(60kg)	Aluminum, zinc, lead, etc.
HRE			980.7(100kg)	Soft materials such as bearing alloys, tin, and hard plastics
HRK			1471(150kg)	

11 The allowable error of the displayed value of the hardness meter (the commonly used scales for Rockwell hardness test are A, B, C) (Table 2)

Table 2

Hardness scale	Hardness range of standard block	Maximum allowable error of indication
HRA	(20 ~ 75)HRA	$\pm 2$ HRA
	(> 75 ~ 88)HRA	$\pm 1.5$ HRA
HRB	(20 ~ 45)HRB	$\pm 4$ HRB
	(> 45 ~ 80)HRB	$\pm 3$ HRB
	(> 80 ~ 100)HRB	$\pm 2$ HRB
HRC	(20 ~ 70)HRC	$\pm 1.5$ HRC
HRD	(40 ~ 70)HRD	$\pm 2$ HRD
	(> 70 ~ 77)HRD	$\pm 1.5$ HRD
HRE	(70 ~ 90)HRE	$\pm 2.5$ HRE



	(> 90 ~ 100)HRE	±2HRE
HRF	(60 ~ 90)HRF	±3HRF
	(> 90 ~ 100)HRF	±2HRF
HRG	(30 ~ 50)HRG	±6HRG
	(> 50 ~ 75)HRG	±4.5HRG
	(> 75 ~ 94)HRG	±3HRG
HRH	(80 ~ 100)HRH	±2HRH
HRK	(40 ~ 60)HRK	±4HRK
	(> 60 ~ 80)HRK	±3HRK
	(> 80 ~ 100)HRK	±2HRK

### 3 Hardness tester installation

#### 1 Working conditions of the hardness tester

1.1 Within the range of 10-30 degrees Celsius at room temperature;

1.2 The indoor relative humidity is not more than 65%;

1.3 In a vibration-free environment, there is no corrosive medium around.

#### 2 Hardness tester unboxing

2.1 Remove the 4 screws that fix the box body, lift the box body, and take out the padding of the guard durometer and the accessory box.

2.2 Raise the bottom plate, use a wrench to unscrew the two M10 bolts under the bottom plate, and the hardness tester will be separated from the bottom plate.

Take out the hardness tester (pay attention to safety).

2.3 The unpacked hardness tester is placed horizontally on a stable workbench, and its levelness does not exceed 1mm/m. with

When opening a hole in the appropriate position of the workbench (Figure 1), the lifting screw can work normally.

### 3 Place the hardness tester (Picture 2)

After the hardness tester is properly placed, open the upper cover (1) and the back cover (2). Fasten the extension rod in the body (22)

Remove the white gauze belt on the upper part (Figure 6), and remove all the white gauze belts that fix the movable parts, and then cover them to prevent dust from entering.

### 4 Installation of weight set (Picture 3)

4.1 When installing the weight, the instrument should be in the state of removing the test force.

4.2 Take out the weight set in the accessory box and wipe it clean. Turn the load-changing handwheel (9) to 588 and take it out from the back cover

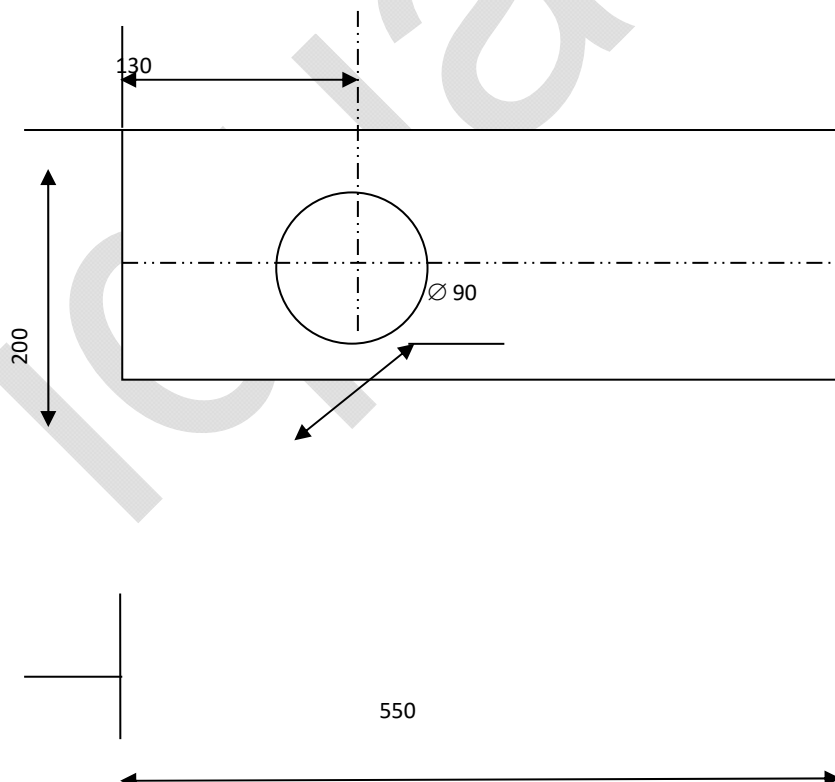
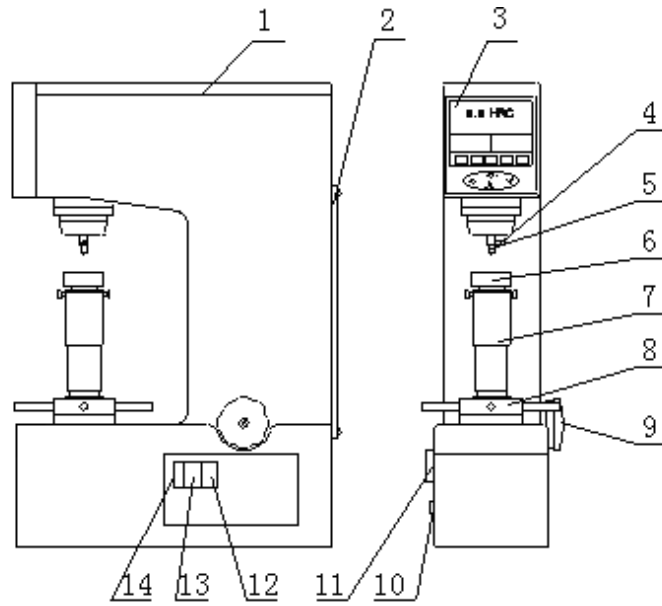
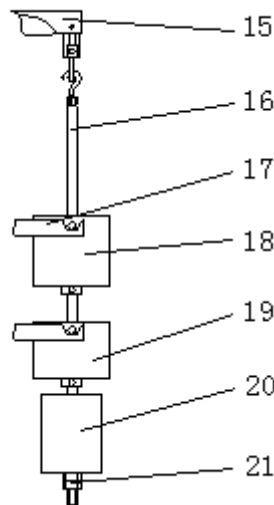


Figure 1



**figure 2**

- 1Upper cover 2Back cover 3Display screen 4Head stop screw 5Indenter 6Test stand  
 7Lifting screw 8 Rotary wheel  
 9Change-of-load handwheel 10 RS-232Jack 11Printer 12AC power plug and socket  
 13Fuse 14Switch



**image 3**

For the boom (16), insert the boom into the hole of weight A (20), screw into the 2 M10 nuts (21) at the tail of the boom, and hook the boom into the lifting lugs at the tail of the lever (15), respectively Put weight B (19) and weight C (18) on the two fork brackets (17), and then turn the load-changing handwheel one circle clockwise to observe whether the cylindrical pins on both sides of the weight are placed in the recess of the fork bracket. In the slot. Rotate the variable load handwheel (9) to 1471. At this time, all the weights are suspended and should not collide with any parts.

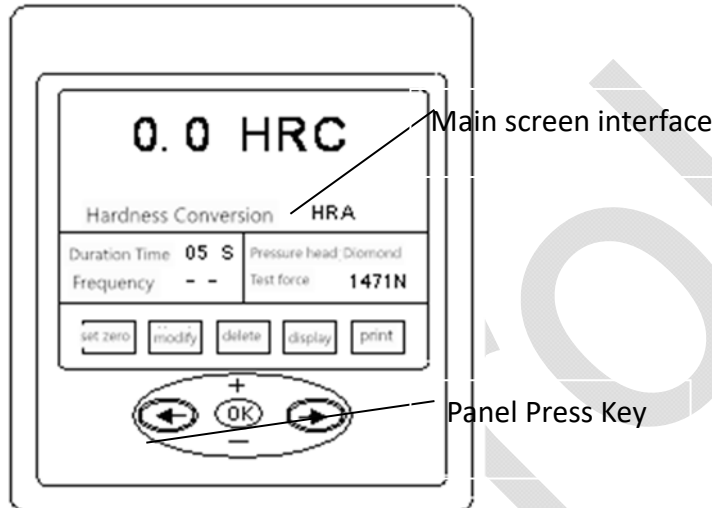
5 Correspondence between selected test force and weight applied (Table 3)

**Table 3**

<b>Ruler</b>	<b>Test force (N)</b>	<b>Engraved value of variable load hand wheel</b>	<b>Force of weight (weight code)</b>
HRA	588.4(60kg)	588	Hanger + weight A
HRB	980.7(100kg)	980	Hanger+weight A+weight B
HRC	1471(150kg)	1471	Lifting weights A weights B weights C

## 4 Introduction to Panel Key Functions

1 Turn on the power supply (12), turn on the boat switch (14), the main screen displays the "Welcome" interface, wait a moment, the main screen appears the operation interface (figure 4)



**Figure 4**

- 1 Set zero-clear in this key, when the test after a little bit of the main screen display hardness zone may leave a decimal, then press the OK key, display hardness zone number is zero (0.0 HR30N).
- 2 Modify—Press to move the cursor to the modification key, press OK, the screen displays Change item, press the key and move the cursor up and down to select: measuring scale, conversion scale, dwell time, date and time. Press OK again, the screen displays the selected item, move the cursor to select, dwell time and date At time, press +-to change the number, and then press the OK key after you have selected it. The main screen will return to your desired operation interface.
- 2 Delete—Move the cursor to this key and press OK to delete the hardness data of the last test.
- 3 Display—Move the cursor to this key (the first point is not displayed), press the OK key, the screen will display the tested hardness value, and calculate the minimum, maximum, average and error values. It can display 12 times at most each time. If you

want to display the last 12 times, press the "modify" key to return the test times to zero.

- 6 Print—Move the cursor to this key (the first point is not printed), press the OK key, and print out. The content includes: year, month, day, error, average value, minimum value, maximum value, hardness value and frequency, etc.

iqualitrol

## 5 Correct use of hardness tester

### 1 Preparation before use

1.1 The surface of the tested piece should be smooth and clean, and there should be no dirt, oxide scale, pits and obvious processing marks.

The supporting surface of the sample and the test bench should be clean to ensure a good fit.

1.2 The minimum thickness of the test piece should be greater than 10 times the depth of the indentation. After the test, there should be no visible deformation marks on the back of the test piece.

1.3 The test piece should be stably placed on the test bench, the test piece must not be moved during the force application, and the test force can be applied perpendicularly to the test piece.

1.4 According to the shape and size of the test piece, choose a suitable test bench. If the test piece is abnormal, you can make a special fixture according to the specific geometry to make the hardness test display correct.

1.5 When the test piece is cylindrical, the "V" type test bench must be used, when the diameter of the test piece is less than 38 (25) mm

When the test result is corrected, the correction value is positive. Correction of Rockwell Hardness Scale for Cylindrical Specimen

Value (table 4)


## 2 operation of the hardness tester

2.1 To test the HRC standard hardness block, select the test force 1471N (150kg) and the diamond indenter according to Table 1.

Turn the variable load handwheel clockwise to determine the total test force.

2.2 Push the indenter (5) into the spindle hole, close to the supporting surface, and face the notched surface of the indenter handle to the screw,

Tighten the indenter stop screw (4) slightly, and then place the HRC hardness block on the test bench (6).

2.3 Press  Key, move the cursor to "Modify", and press OK. Display the "Modify Items" form,

Select "measurement ruler" and press OK key, the main screen will display 12 hardness test rulers, select HRC, press OK button, the main screen returns to the test state.

2.4 According to the operation method in Article 2.3, select the conversion scale and dwell time for testing hardness.

2.5 The rotating wheel (8) rotates clockwise, the lifting screw (7) rises, and the test piece should be slowly and without impact

Touch until the hardness meter displays between 570 and 610, at this time the test bench (6) stops rising, and the hardness meter automatically applies the test force. (When the test bed rises too fast and the displayed value exceeds 610, the buzzer will beep for a long time, prompting an operation error. The test bed should be lowered, and the test piece position should be changed before testing).

2.6 The test force is automatically applied, and the holding time is 5 seconds. At this time, the second counts down, from 5 to 0, when the motor rotates, the test force is automatically removed, the buzzer sounds, and the hardness test value of the



display screen is read.

**Note: When loading and unloading the test force, it is strictly forbidden to turn the load-changing handwheel (9). If it is rotated hard, the internal gear will be misaligned and the test force will be confused.**

### Preparation and selection of test pieces

The sample should have a certain size and thickness, and should be able to ensure that the distance between adjacent indentation centers and the indentation center to the edge of the test piece is greater than 3 mm, and the minimum thickness of the test piece shall not be less than eight times the indentation depth. After the test, there should be no obvious deformation marks on the supporting surface of the sample. The minimum thickness depends on the material and the applied load. You can refer to the following table of minimum sample thickness.

Minimum thickness of specimen

Ruler	Hardness value HR	Minimum thickness (mm)	Ruler	Hardness valueHR	Minimum thickness (mm)
A	70	0.7	B	80	1.0
	80	0.5		90	0.8
	90	0.4		100	0.7
B	25	2.0	C	20	1.5
	30	1.9		30	1.3
	40	1.7		40	1.2
	50	1.5		50	1.0
	60	1.3		60	0.8
	70	1.2		67	0.7

2.7 Rotate the rotary wheel (8) in the opposite direction, the test table (6) will drop, change the test point of the test piece, and repeat the above operation.

Hardness value  <b>HR</b>	Cylindrical specimen diameter (mm)								
	<b>6</b>	<b>10</b>	<b>13</b>	<b>16</b>	<b>19</b>	<b>22</b>	<b>25</b>	<b>32</b>	<b>38</b>
	Corrections to Rockwell A, C and D scales (HR)								

**Table 4**

2.8 There should be no less than five test points on each test piece (the first point is not counted). Inspection of large quantities of parts  
 Th points can be reduced appropriately.

20				2.5	2.0	1.5	1.5	1.0	1.0
25			3.0	2.5	2.0	1.5	1.0	1.0	1.0
30			2.5	2.0	1.5	1.5	1.0	1.0	0.5
35		3.0	2.0	1.5	1.5	1.0	1.0	0.5	0.5
40		2.5	2.0	1.5	1.0	1.0	1.0	0.5	0.5
45	3.0	2.0	1.5	1.0	1.0	1.0	0.5	0.5	0.5
50	2.5	2.0	1.5	1.0	1.0	0.5	0.5	0.5	0.5
55	2.0	1.5	1.0	1.0	0.5	0.5	0.5	0.5	0
60	1.5	1.0	1.0	0.5	0.5	0.5	0.5	0	0
65	1.5	1.0	1.0	0.5	0.5	0.5	0.5	0	0
70	1.0	1.0	0.5	0.5	0.5	0.5	0.5	0	0
75	1.0	0.5	0.5	0.5	0.5	0.5	0	0	0
80	0.5	0.5	0.5	0.5	0.5	0	0	0	0
85	0.5	0.5	0.5	0	0	0	0	0	0
90	0.5	0	0	0	0	0	0	0	0
Hardness value (HR)	Diameter of cylindrical specimen (mm)								
	<b>6</b>	<b>10</b>	<b>13</b>	<b>16</b>	<b>19</b>	<b>22</b>	<b>25</b>		
	Revision of Rockwell B, F and g scales (HR)								

20				4.5	4.0	3.5	3.0
30			5.0	4.5	3.5	3.0	2.5
40			4.5	4.0	3.0	2.5	2.5
50			4.0	3.5	3.0	2.5	2.0
60		5.0	3.5	3.0	2.5	2.0	2.0
70		4.0	3.0	2.5	2.0	2.0	1.5
80	5.0	3.5	2.5	2.0	1.5	1.5	1.5
90	4.0	3.0	2.0	1.5	1.5	1.5	1.0
100	3.5	2.5	1.5	1.5	1.0	1.0	0.5

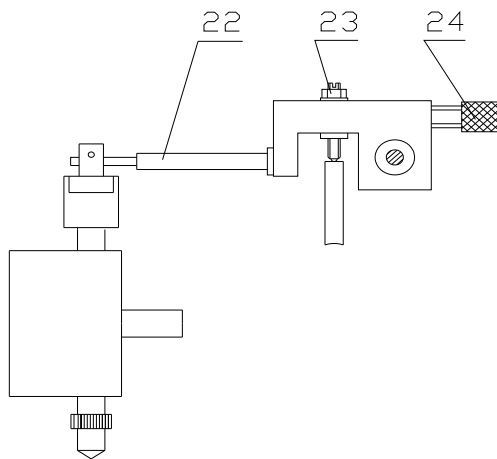
2.9 Move the cursor to the "Print" button and press the OK button to print out. Complete the operation.

### 3 Hardness display value adjustment (Figure 6)

The indication accuracy of the hardness tester has been calibrated before leaving the factory. If the error caused by the transportation process, the test personnel

Make appropriate adjustments on the basis of understanding the principle of the instrument structure. Method: Remove the upper cover (1). If the measured value is lower than the standard hardness block, first use a screwdriver to push it into the groove of the screw (23), loosen the nut, but do not allow the screw (23) to rotate. Screw the adjusting screw (24) clockwise into the <screw (23) move forward> slightly, turn it half a turn, and adjust it to about 1 degree, then tighten the nut on the screw (23) slightly in the same way as above. Re-test the displayed value until it is adjusted to the specified error range (Table 2). If the measured value is higher than the hardness value of the standard block, turn the adjusting screw (24) in the opposite direction (screw (23) moves

backward).



22 extension bar

23 Screw

24 Adjusting screw

Figure 6

## 6 RS-232 Super Terminal Settings

The connection method between the hardness tester and the computer is as follows:

1 Before turning on the hardness tester, take out the RS-232 communication line in the accessory box and connect the hardness tester to the computer (computer

The power must be turned off), the 9-pin pin is inserted into the 9-pin output socket (10) of the hardness tester, and the other 9-pin is inserted into the COM port of the computer.

2 Turn on the computer and click Start on the computer interface. Programs Accessories Communication Super terminal.

3 Pop up the "Connection Description" dialog box, enter "AA" in the name field, and press the OK key. Jump out of the "connect to" pair

Dialog box. In the dialog box "Use (N) when connecting" to directly connect to the serial port COM1 (or COM2), press OK

Fixed key.

4 "COM1 (or COM2) Properties" dialog box, enter "9600" for baud rate (B), and other items

No change, press the OK key to enter the AA hyper terminal interface and save the session AA.

5 When the computer operating platform is Windos98, the HyperTerminal may not be installed in the program.

On the interface, click Start, Settings, Control Panel, Add or Remove Programs, and install HyperTerminal.

6 After the hardness test is completed, the content of the printout is consistent with the computer display.

## **7 Maintenance and precautions of hardness tester**

1 The test personnel should abide by the operating procedures and can often use standard blocks to calibrate the instrument before and after the test. Not often used After turning on the hardness tester, it is necessary to perform several hardness measurements on the standard block. After it is stable, the test piece is tested.

2 In the hardness test, when applying test force, maintaining test force, and removing test force, it is strictly forbidden to turn the variable load handwheel.

3 The hardness block can only be used on the working surface, and the distance between two adjacent indentations and the center of the indentation is not less than 3mm, its service life is two years.

4When transporting the hardness tester, the extension rod should be fixed, and the weight and boom should be removed. Before removing weights and booms, Unplug the power plug first.

5 The hardness tester should be kept clean and put on a dust cover after testing. Apply anti-rust oil to the hardness block and ball indenter after use.

6 The hardness tester shall perform periodic verification work at least once a year to ensure the accuracy of the hardness tester.

7 Common troubleshooting of hardness tester

When the hardness tester fails, it should be repaired with the relevant units. The common faults can be solved by themselves (Table 5)

phenomenon	Possible Causes	Method of exclusion
When you turn it on, the screen is not on	1 Power failure 2 blown fuse	1 Check that the power cord is on 2 Remove fuse replacement in attachment box
The button failed when it turned on	The instrument is inactive	After turning on, wait a moment, the instrument automatically returns to work
Lift screw stuck	The fit gap between the lifting screw is very small, and the small thread or dirt may cause jam	Remove the lifting screw protective cover, wipe the thread with a clean cloth, and then hold the rotary wheel up and down to pull the lifting screw (no sand paper friction screw).

<p>The deviation of hardness indication large.</p>	<p>1 The head is damaged.                  2 Weight installation order upside down.                  3 The instrument is not horizontal and the weight is rubbed with the inner wall of the body.                  4 Total test force or head selection error.</p>	<p>1 Replace diamond head or ball head.                  2 Install weights as shown in Figure .                  3 Calibrate the hardness meter with a level meter in accordance with paragraph 2.4 of Chapter 3, Article 2.                  4 Select test force and pressure head according to Table 1.</p>
--	--	---

**Table 5**