



Digital Twin Rockwell Hardness Tester
iRock Series
Operation Manual

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Preface

1 Carefully read the Operation Manual before you use the hardness tester and get to know thoroughly the operation procedure and the usage precautions so as to avoid the damages to the hardness tester and the safety accidents caused by the improper operation.

2 All the bands and the anti-shock tapes should be carefully removed before the hardness tester is installed and calibrated.

3 The single-phase 3-pin socket should be used for the power source of the hardness tester and the ground connecting cable should meet the safety requirements.

4 It is strictly prohibited to tamper with the installed position of all the electric component parts, switches, and sockets of the hardness tester without permission, otherwise it will cause accident.

5 Our company tries to improve the quality of the hardness testers and renew their structure. In case the contents in the Operation MANUAL are a bit different with the actual structure of the instrument, it is hoped and apologized for the fact that the further notice will not be given.

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1. iRock Series Brief Introduction

1.1 Hardness is one of the important mechanic characteristics of metal materials, while the hardness testing is an important method to judge the quality of the metal material or its component parts. The hardness of the metal is correspondent to its other mechanic characteristics, so its mechanic characteristics such as the strength, tiredness, wriggling and wearing out can be tested out approximately through its hardness testing.

1.2 The Touch Screen Digital Rockwell Hardness Tester is equipped with a newly-designed large display screen with good reliability, excellent operation and intuitive reading, thus it is a high-tech product combining the mechanic and electric features. Its main function is as follows:

1.2.1 Available to test all Rockwell scales.

1.2.2 Plastic Rockwell scales (optional).

1.2.3 Hardness conversion among different hardness scales.

1.2.4 Test data reviewing and analysis.

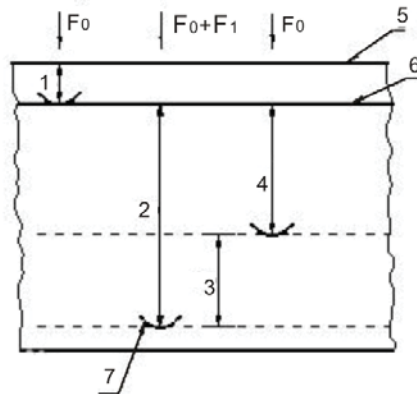
1.2.5 Optional wireless printer to print test data.

2. Technical Data and Working Principle

2.1 Technical Data

Product Name	Full Auto Rockwell Hardness Tester	Full Auto Superficial Rockwell Hardness Tester	Full Auto Twin Rockwell Hardness Tester
Model	iRock-DR1	iRock-SR1	iRock-TR1
Code #	811-330	811-340	811-350
Rockwell Scales	HRA、HRB、HRC、HRD、HRE、HRF、HRG、HRH、HRK、HRL、HRM、HRP、HRR、HRS、HRV	HR15T、HR30T、HR45T、HR15W、HR30W、HR45W、HR15X、HR30X、HR45X、HR15Y、HR30Y、HR45Y、HR15N、HR30N、HR45N	HRA、HRB、HRC、HRD、HRE、HRF、HRG、HRH、HRK、HRL、HRM、HRP、HRR、HRS、HRV、HR15T、HR30T、HR45T、HR15W、HR30W、HR45W、HR15X、HR30X、HR45X、HR15Y、HR30Y、HR45Y、HR15N、HR30N、HR45N
Initial Force	10kgf(98.1N)	3kgf(29.4N)	10kgf(98.1N);3kgf(29.4N) Permitted Error $\pm 2.0\%$
Full Force	60kgf(588.4N) ,100kgf(980.7N) ,150kgf(1471N)	15kgf(147.1N),30kgf(294.3N),45kgf(441.3N)	60kgf(588.4N),100kgf(980.7N),150kgf(1471N),15kgf(147.1N), 30kgf(294.3N),45kgf(441.3N) Permitted Error $\pm 1.0\%$
Dwell Time	1-60s Adjustable		
Display	8 inch Touch Screen , Resolution 1024*768		
Hardness Resolution	0.1HR		
Loading Control	Auto Loading, Dwell and Unloading, Force Change		
Hardness Conversion	HRC、HV、HBS、HBW、HK、HAR、HRD、HR15N、HR30N、HR45N、HS、HRF、HR15T、HR30T、HR45T、HRB		
Conversion Standard	ASTM、DIN		
Language	English		
Correction Range	-3.0HR~+3.0HR; Step 0.1HR		
Data Process	2000 single measuring result, curve analysis, results reviewing and analysis		
Printing	Optional Wireless Printer		
Max Height of Specimen	280mm		
Throat	170mm		
Power Supply	AC220V/50Hz ; AC110V/60Hz/200W		
Outer dimension	615×225×885 (mm)		
Packing Dimension	670×440×1000 (mm)		
Gross/Net Weight	140Kg/120Kg		
Standards	GB/T230.2、JIS Z2245、ASTM—18、EN-ISO6508		

2.2 Working Principle



The Rockwell test consists of measuring the additional depth to which a carbide ball or diamond penetrator is forced by a heavy (major) load beyond the depth of a previously applied light (minor) load (SET point).

The minor load is applied first and a SET position is established on the dial gauge or displacement sensor of the Rockwell tester. Then the major load is applied. Without moving the piece being tested, the major load is removed and, with the minor load still applied, the Rockwell hardness number is automatically indicated on the dial gauge or digital display.

The diamond penetrator is used for testing materials such as hardened steels and cemented carbides. The carbide ball penetrators, available with 1/16 inch, 1/8 inch, 1/4 inch, and 1/2 inch diameter, are used when testing materials such as steel-copper alloys, aluminum and plastics to name a few.

Rockwell Principle:

- 1—Depth of Initial Loading Force F_0
- 2—Depth of Total Loading Force $F_0 + F_1$
- 3—Depth after Removed Main Force F_1
- 4— h is remnant penetrate depth
- 5—Surface of Specimen
- 6—base level
- 7—Indenter Position

Rockwell Hardness Formula

$$HR = N - \frac{h_1 - h_0}{S}$$

In this Formula:

- N - constant value , For scales A、C、D、N、T , $N=100$; the other scales , $N=130$;
- h - remnant penetrate depth , mm ;
- S - constant value , for Rockwell scales , $S=0.002\text{mm}$, for superficial Rockwell scales , $S=0.001\text{mm}$. Each Rockwell Unit corresponding indentation depth, Rockwell hardness is 0.002mm , superficial rockwell is 0.001mm, the depth is lighter, the hardness value is bigger.

The diamond penetrator is used for testing materials such as hardened steels and cemented carbides. The carbide ball penetrators, available with 1/16 inch, 1/8 inch, 1/4 inch, and 1/2 inch diameter, are used when testing materials such as steel-copper alloys, aluminum and plastics to name a few. See below table for details:

1) Rockwell Scales:

Rockwell Scale	Hardness Symbol	Indenters	Initial Force F_0/N	Main Force F_1/N	Total Force F/N	Hardness Range
A	HRA	120° Cone Diamond Indenter	98.07	490.3	588.4	20 ~ 88HRA
B	HRB	1.5875mm Ball Indenter	98.07	882.6	980.7	20 ~ 100HRB
C	HRC	120° Cone Diamond Indenter	98.07	1373	1471	20 ~ 70HRC
D	HRD	120° Cone Diamond Indenter	98.07	882.6	980.7	40 ~ 77HRD
E	HRE	3.175mm Ball Indenter	98.07	882.6	980.7	70 ~ 100HRE
F	HRF	1.5875mm Ball Indenter	98.07	490.3	588.4	60 ~ 100HRF
G	HRG	1.5875mm Ball Indenter	98.07	1373	1471	30 ~ 94HRG
H	HRH	3.175mm Ball Indenter	98.07	490.3	588.4	80 ~ 100HRH
K	HRK	3.175mm Ball Indenter	98.07	1373	1471	40 ~ 100HRK

2) Superficial Rockwell Scales:

Superficial Rockwell Scale	Hardness Symbol	Indenter	Initial Force F_0/N	Main Force F_1/N	Total Force F/N	Hardness Range
15N	HR15N	120° Cone	29.42	117.7	147.1	70~94HR15N
30N	HR30N			264.8	294.2	42~86HR30N

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45N	HR45N	Diamond Indenter		411.9	441.3	20~77HR45N
15T	HR15T	φ1.588mm Ball Indenter	29.42	117.7	147.1	67~93HR15N
30T	HR30T			264.8	294.2	29~82HR30T
45T	HR45T			411.9	441.3	1~72HR45T

3) Twin Rockwell Scales:

Hardness Scale	Symbol	Indenter	Initial Force F ₀ /N	Main Force F ₁ /N	Total Force F/N	Hardness Range
A	HRA	120° Cone Diamond Indenter	98.07	490.3N	588.4N	20~88HRA
B	HRB	1.5875mm Ball Indenter	98.07	882.6N	980.7N	20~100HRB
C	HRC	120° Cone Diamond Indenter	98.07	1373N	1471N	20~70HRC
D	HRD	120° Cone Diamond Indenter	98.07	882.6N	980.7N	40~77HRD
E	HRE	3.175mm Ball Indenter	98.07	882.6N	980.7N	70~100HRE
F	HRF	1.5875mm Ball Indenter	98.07	490.3N	588.4N	60~100HRF
G	HRG	1.5875mm Ball Indenter	98.07	1373N	1471N	30~94HRG
H	HRH	3.175mm Ball Indenter	98.07	490.3N	588.4N	80~100HRH
K	HRK	3.175mm Ball Indenter	98.07	1373N	1471N	40~100HRK
15N	HR15N	120° Cone Diamond Indenter	29.42	117.7N	147.1N	70~94HR15N
30N	HR30N			264.8N	294.2N	42~86HR30N
45N	HR45N			411.9N	441.3N	20~77HR45N
15T	HR15T	1.5875mm Ball Indenter	29.42	117.7N	147.1N	67~93HR15T
30T	HR30T			264.8N	294.2N	29~82HR30T
45T	HR45T			411.9N	441.3N	1~72HR45T

3. Installation

3.1 Working Condition

3.1.1 Under the room temperature between 10~30°C.

3.1.2 The relative humidity in the test room $\leq 65\%$.

3.1.3 Without vibration, corrosive medium and serious dust in the surrounding environment.

3.2 Unpacking

3.2.1 Cut the belts on the packing box, screw off the screws on the bottom plate of the box and remove off the upper body of packing box. Take out the accessories kit.

3.2.2 Unscrew the two (2) M10 outer hexagonal bolts under the bottom plate with a spanner, to separate the hardness tester from the bottom plate (take care of the safety).

3.2.3 After unpacking, the tester shall be placed on a stable and solid working table with horizontal deviation less than 1mm/m (There is a level in the accessories kit) .A hole shall be drilled at a proper location on the working table (see Fig.1) to enable the Up and Down Lead Screw to operate properly. We suggest that the height of working table should be about 500mm.

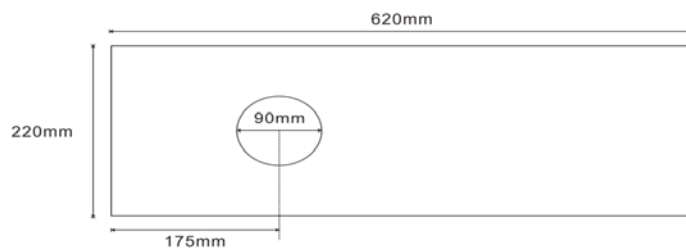


Fig 3-1

3.2.4 After the hardness tester is properly placed, open the Upper Cover and the Back Cover. Untie the fastening rubber tape on the Connecting Rod and draw out the foam block under Protecting Gasket and Lever. Untie all the white gauzes on moving parts and then recover the tester to keep away dust.



1. Take care during unpacking and installation, avoid damage of tester parts.
2. Understand well components structure and avoid wrong operation.

3.3 Parts Illustration

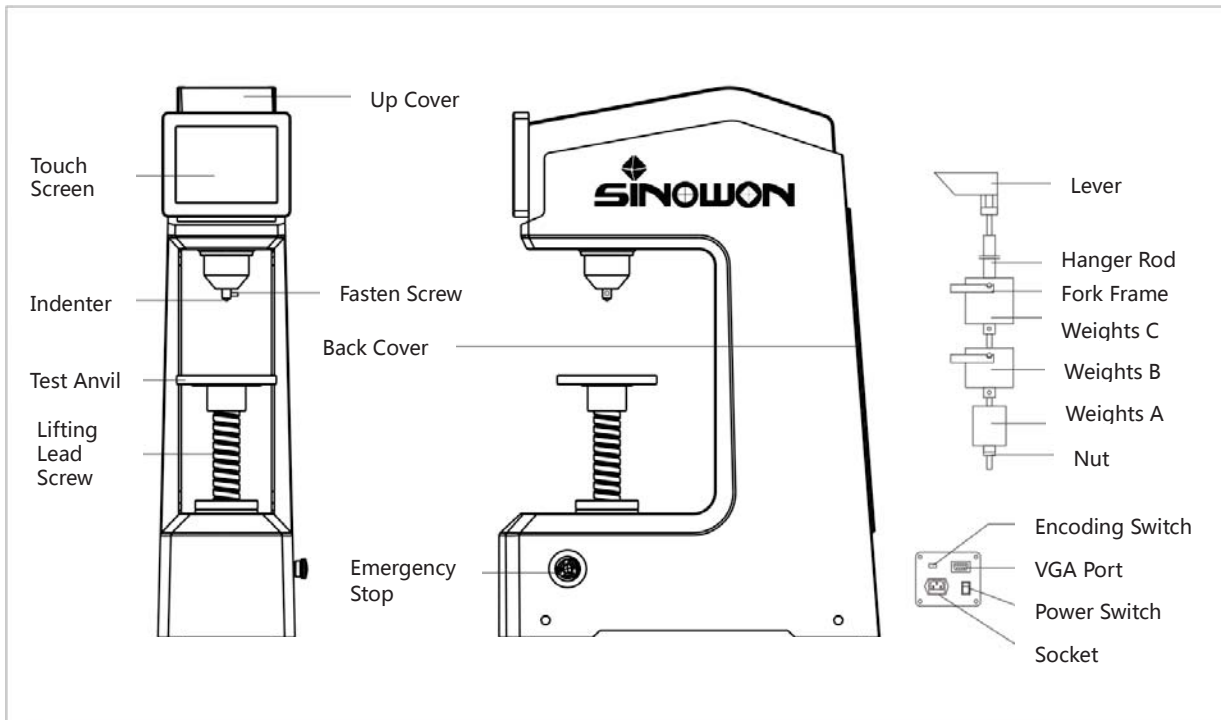


Fig 3-2 Rockwell Hardness Tester Components Illustration

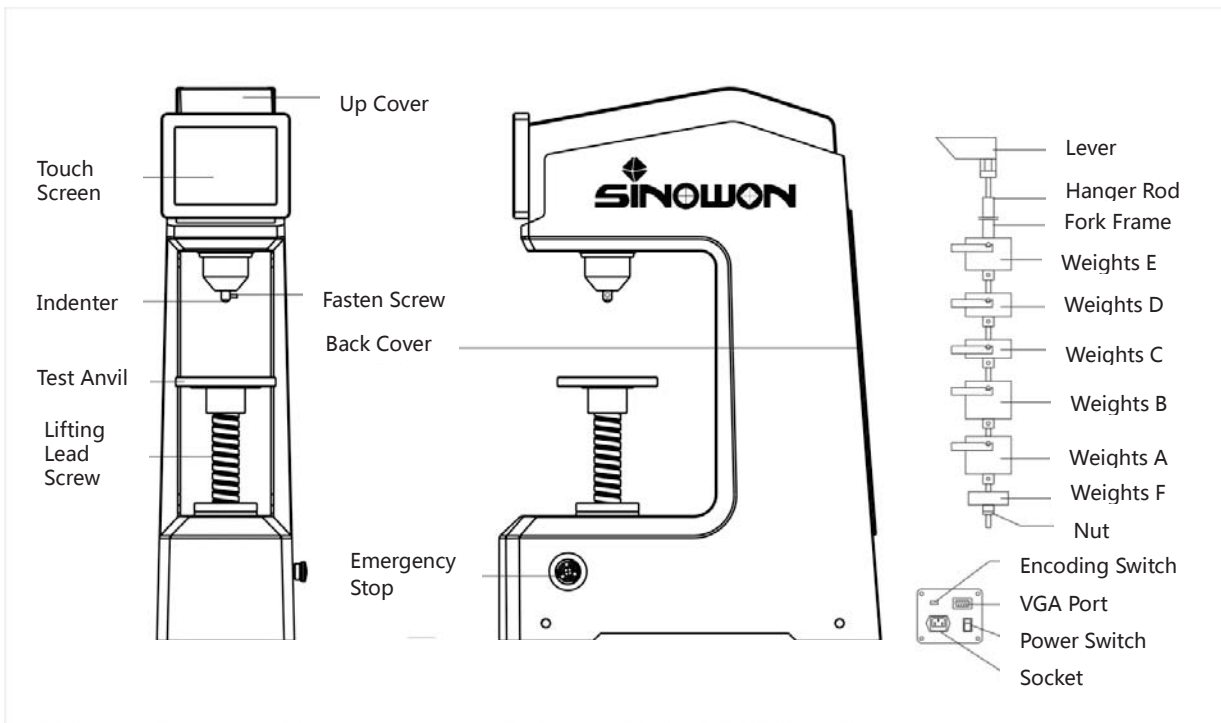


Fig 3-3 Twin Rockwell Hardness Tester Components Illustration (6 Weights)

3.4 Weights Installation

3.4.1 During installation of weights, the instrument should be in the state unloading.

3.4.2 Take the weights group out of the accessories kit and clean them thoroughly. Rotate the Load-Change Hand

Wheel to the place number 588, and then take the Hanging Rod from the Back Cover and insert it in the hole of the Weight A , fasten the M10 Nut at the tail of the Hanging Rod. Hook the Hanging Rod in the ear of the tail of the Lever . And then place the weight B and Weight C separately on two Fork-Shaped Frames. At this point, rotate the Load-Change Hand Wheel clockwise for a whole cycle and observe the round pegs on both sides of the Weight and see if they are properly placed in the groove of the Fork-Shaped Frame. The Weights should not touch the inside wall of the instrument body (See Fig 3-2).

3.4.3 Twin Rockwell Tester Weights Installation, the step is same with Rockwell tester, but with two more weights. See Fig 3-3.

3.5 Force and Weights Table

1) Rockwell Scales and Weights Table

Scale	Force (N)	Weights Force
HRA	588.4(60kg)	Hanger Rod + Weights A
HRB	980.7(100kg)	Hanger Rod +Weights A+Weights B
HRC	1471(150kg)	Hanger Rod +Weights A+Weights B+ Weights C

2) Superficial Rockwell Scales and Weights Table

Scale	Force (N)	Weights Force
15N(T)	147.1(15kg)	Hanger Rod+Weights F
30N(T)	294.2(30kg)	Hanger Rod+Weights D
45N(T)	441.3(45kg)	Hanger Rod+Weights E

3) Twin Rockwell Scales and Weights Table

Scale	Force (N)	Weights Force
HRA	588.4(60kg)	Hanger Rod+Weights A
HRB	980.7(100kg)	Hanger Rod +Weights A+Weights B
HRC	1471(150kg)	Hanger Rod +Weights A+Weights B+ Weights C
15N(T)	147.1(15kg)	Hanger Rod+Weights F
30N(T)	294.2(30kg)	Hanger Rod+Weights D
45N(T)	441.3(45kg)	Hanger Rod+Weights E

4. Power on Operation

4.1 Power On

4.1.1 Connect the power source, turn on the boat-shaped Switch, the main Screen appears the operation page, Fig 4-2.



Fig 4-1 Power on Screen

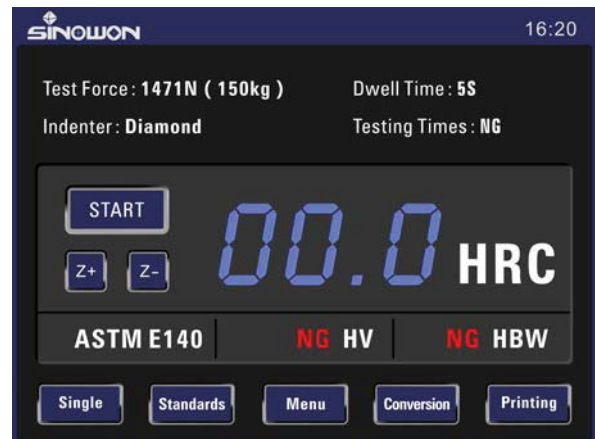


Fig 4-2 Main Page

4.1.2 Main Page Illustration

Loading Control—Click Z+ on LCD, then test anvil ascending, click Z+ again, it stops.

Click Z- on LCD, then test anvil descending, click Z- again, it stops.

Total Loading Force—Force is automatically changing after selected specific scale. For example when scale is C/G/K, the force shows 1471N(150kg); when scale is B/D/E, the force shows 980.7N(100kg); when scale A/F/H, force shows 588N (60kg) .

Indenters—When selected specific hardness scales, on screen shows corresponding indenter, but need manually replace the indenter.

- ◆ **Note 1** : Before testing, select suitable loading force and indenter according to test specimens, in accessory case, there is cone diamond indenter and 1.588 ball indenter.
- ◆ **Note 2** : Click force, it can change between unit KG/N.

During testing, it will show one by one from Loading, Dwell to Unloading, then display testing results.

4.2 Touch Screen Operation

- **Single/Group** : Standard test mode (Single) and group test mode (batch mode) switch.
- When show single, enter standard test mode, test number show NG; See fig4-2 click single, it will show average, enter batch mode, test number show 00.
- **Standard** : Hardness conversion according to different standards
- **Menu** : Enter system setup interface.
- **Conversion** : Select hardness conversion scales.
- ◆ **Note** : Under loading, click conversion and standard, it is valid under result displayed.
- **Printing** : To print test result.

5. Detail Operation of Hardness Tester

5.1 System Setup



Fig 5-1 System Setup

- Rockwell Scales setup: See Fig 5-2, and click the small box in front of each scale, total 21 rockwell scales: HR15N, HR30N, HR45N, HE15T, HR30T, HR45T, HRA, HRB, HRC, HRD, HRE, HRF, HRG, HRH, HRK, HRL, HRM, HRP, HRR, HRS, HRV.
- ◆ **Note:** After selected specific scale, the force and indenter type will change.
- **Hardness Conversion Scale Setup :**
 - 1) **【Conversion Scale】** : Click the small box in front of each scale and can click 2 scales at a time, total 16 scales, HRC, HV, HBS, HBW, HK, HRA, HRD, HR15N, HR30N, HR45N, HS, HRF, HR15T, HR30T, HR45T, HRB. See Fig5-3.
 - ◆ **Remark :**
 - a) Conversion value displays under hardness test result, if conversion value exceeds valid range, it will display NG.
 - b) When change hardness conversion value, it can also change saved scale and show corresponding value.
 - c) Click one more time for selected scale, means cancel the selection.
 - 2) **【Conversion Standard】** : Under conversion scales, there are 2 options ASTM and DIN. (Fig 5-3).

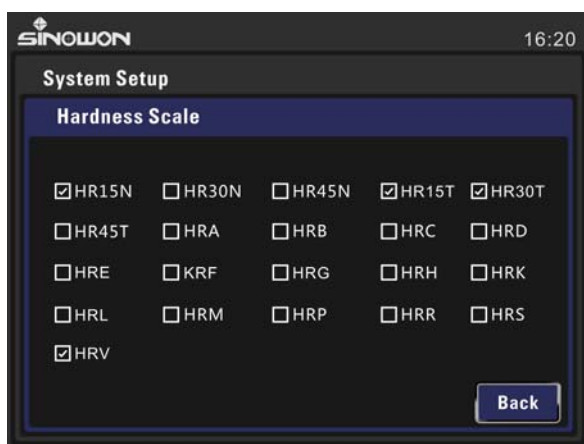


Fig 5-2 Hardness Conversion

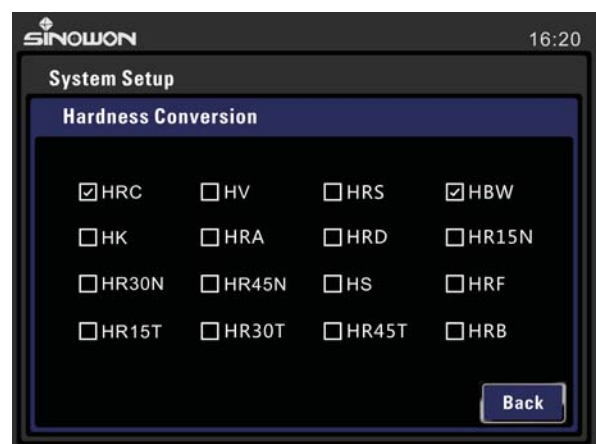


Fig 5-3 Conversion Scales and Standards

- Dwell time setup, adjust from 1-60s (Fig 5-4) , default set dwell time is 5s, for soft materials, advise lengthen

dwelt time.

- **Language Setup:** Click Language to select operation language (Fig 5-5).



Fig 5-4 Dwell Time Setup

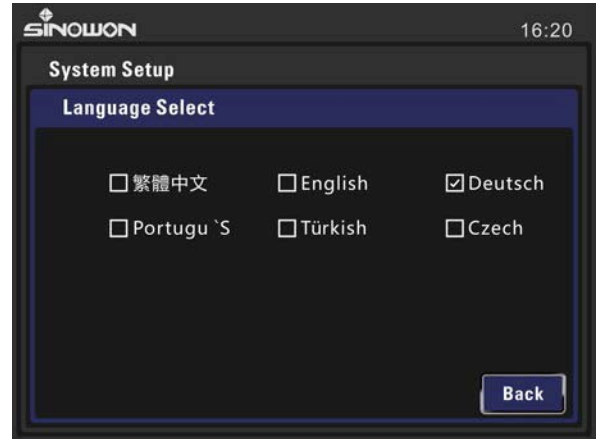


Fig 5-5 Language Setup

- **[Date Setup]** : Click to modify year, month and date, click ENTER update system time. (Fig 5-6)
- **Print Setup** : Click connect printer, to print test results by blue tooth printer (Optional) Fig5-7.
 - 1) Click connect the printer.
 - 2) If Blue Tooth Printer is power on, after a few seconds, searched available devices, click Connect, system will connect with printer, then show connect OK, then press [PRT] on panel can print.
- ◆ **Note** : 1.If printer is power off, then system will show Failed
 2.After the first time connect successfully, then no need to connect every time when need print, just press [PRT] to print. While if power off hardness tester, then you need to reconnect printer like above steps.



1. Make sure blue tooth is power on before connect with hardness tester.
2. Blue tooth sensor range is 1–3 meter.
3. Connect one time is OK.
4. If hardness tester is powered off, then reconnect Blue tooth once restart hardness tester.
5. If connect failure, then reconnect again.

- **Wireless Data Transferring :**

Setup Steps as below for data transferring by different operation system :

- 1) **Window XP** : Desktop Start Program Accessories Communicate Hyper Terminal ,then pop up new window Edit connect name Click OK to finish
 - 2) **Win7 or Higher Version** : Win7 or higher version does not include hyper terminal, users can download from internet and install it.
- ◆ **Note** : First time use hyper terminal need set location.



Fig 5-6 Time and Date Setup

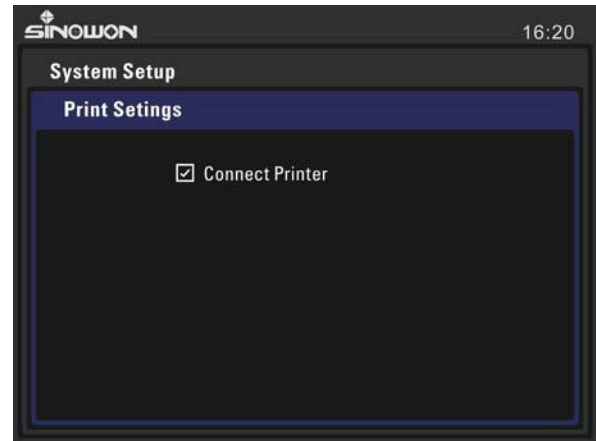


Fig 5-7 Printing Setup

- **Other Setup** : Click other setup, there are 3 sub-menu, see Fig5-8, click means enable, otherwise means disable.
 - 1) **[Sound]** , Click sound, switch on system sound.
 - 2) **[Default Name]** Click enable default name, then will display name edit dialog box, then input name and click Enter to confirm.
 - a) Name consist set name and number, see Fig 5-11, the saved name is Name01. If not click, default name is 16 digits 0 and increases.
 - b) When use set name of data, it shows like name + digits, like Name01, the coming is Name02, etc.
 - 3) The maximum number of tests, this is only for average mode.
- ◆ **Remark** :This function is only for average mode, max test 10 measurements as a group, then auto turn to next group.
- Information is to see serial number, version and mode.

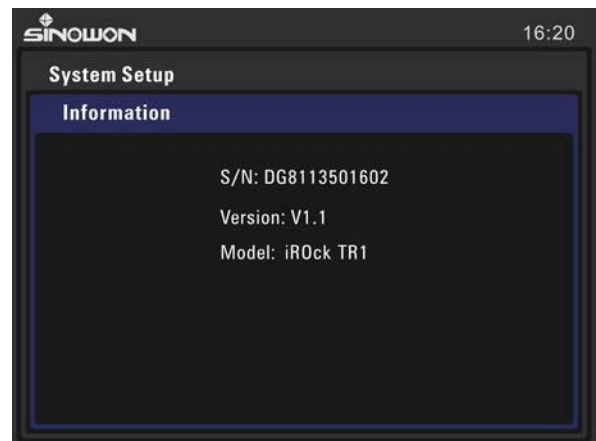


Fig 5-8 Other Setup

Fig 5-9 Product Information

5.2 Preparation Before Operation

5.1.1 The surface of the specimen should be smooth and clean without any feculence, oxidized peels, concaves and the outstanding machining signs. The supporting plane of specimen and the testing table should be clean to assure a good smoothness between them.

5.2.2 The Min. thickness of the specimen should be 10 times superior to the depth of the indentation. After the test,

the back of the specimen should not have any visible signs of deformation, see Fig5-10.

5.2.3 The specimen should be stably fixed on the testing anvil. There should be no any movement of the specimen during the loading of test force and the test force should be loaded perpendicularly on the specimen.

5.2.4 The testing table should be chosen according to the shape and size of the specimen. If the specimen has an irregular shape, a special holder should be made in accordance with the particular geometrical shape, so as to measure out correct hardness displaying values.

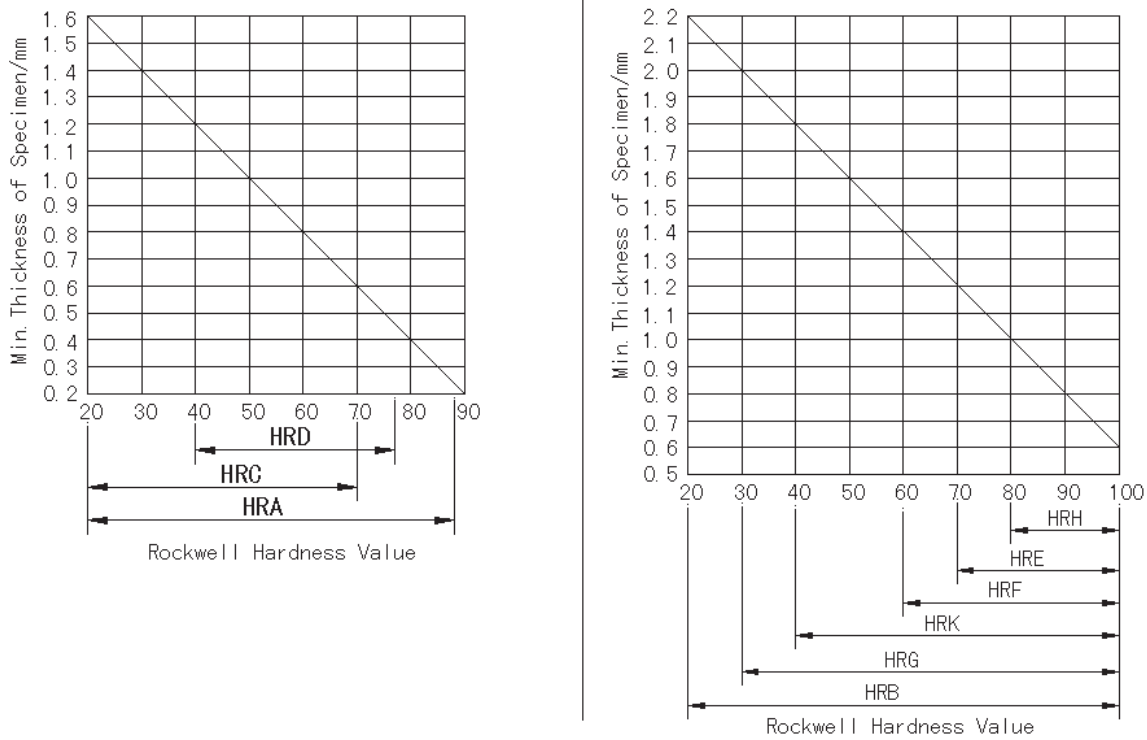


Fig 5-10 Min. thickness of specimen

5.2.5 When the specimen is columned in shape, the V-shaped testing table must be used. The results of the test should be revised. The revised values are all positive numbers. The revised values of the Rockwell Hardness Scales for the convex columned specimen are as Table

5.3 Operation Steps

Test HRC standard hardness block as an example:

5.3.1 Select the test force 1471N (150kg) and the diamond indenter.

5.3.2 Push the Indenter into the hole of main spindle closely against the supporting plane and make the caved plane of the indenter handle face the screw. Fasten slightly the Fastening Screw of Indenter, and then place the hardness block on the Testing anvil.

5.3.3 Press MENU enter System Setup.

- 1) Select scale, then press ENT display dialog box, select HRC, and standard ASTM (Fig5-2) .
- 2) Select hardness conversion scale (Fig5-3) .
- 3) Setup dwell time (Fig5-4) .

4) Press ESC back to main interface.

5.3.4 Start power, auto loading main force, see Fig5-11, when dwell time count down to 0, auto remove main force and display hardness result, see Fig 5-12, click Printer to print hardness results.

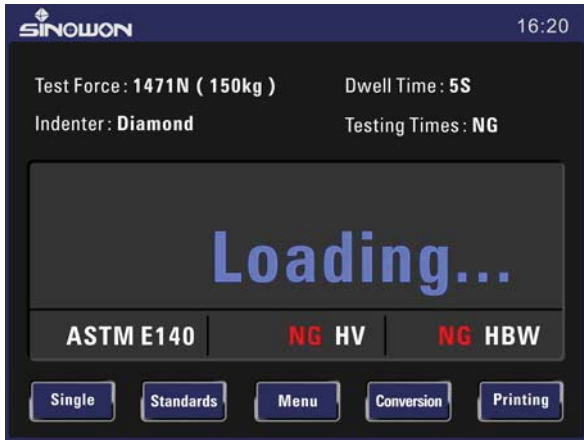


Fig 5-11 Loading Page



Fig 5-12 Hardness Result

5.3.5 The number of the point to be tested is not less than 5 (the first point in not include.) The number of the points to be tested may be reduced a bit for the specimen tested in a serial.



1. Specimen must be put on test anvil horizontally, without any vibration and deformation.
2. Make sure force was vertical stressed on specimen.


5.4 Data Reviewing

5.4.1 Single measurement data viewing

Click data viewing, enter Fig5-13, this page is the list of single measurement result, click list, details and graph to view.

- 1) **List** : Each page displays 5 results, the last result display on first one of list page, click page up, page down to view more.
- 2) **Details** : Shows single measurement details, like testing time, hardness scales, conversion standard, under list page, click details to display first result, or click data name enter to see details.
- 3) **Graph**: Select less than 10 measurements, then click Graph, system will show you the curve and obviously see the tendency, difference, Max, Min data :
 - a) AVE : Average data ;
 - b) S : Standard deviation ; if shows "Err" , means exceeds permitted error ;
 - c) %S : Percentage of deviation ; if shows "Err" , means exceeds permitted error ;
 - d) %RE : Repeatability. The value is small, means hardness is stable.

4) About printing :

- a) Print single result : Click Print (or press [PRT] on panel) on the page of list or details can print single resul.
- b) Group Print : Click  (or press [PRT] on panel) on graph page.

5.4.2 Group Data Viewing

Click group data viewing, enter page show as Fig5-14, this page is average measurement analysis, or show curve.

5.4.3 Quick Data Viewing

Click data review and enter to reviewing page, this function is available for single and group measurements.

- ◆ **Remark :** Under group test mode, if the measurements less than max set number, the result display is last measurement. If need to see current result, quit group mode and review again.

5.4.4 If there is no data saved, click data review will show NO DATA.

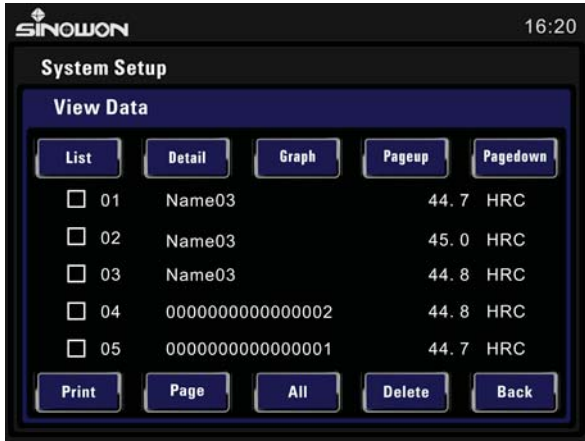


Fig 5-13 Data Review

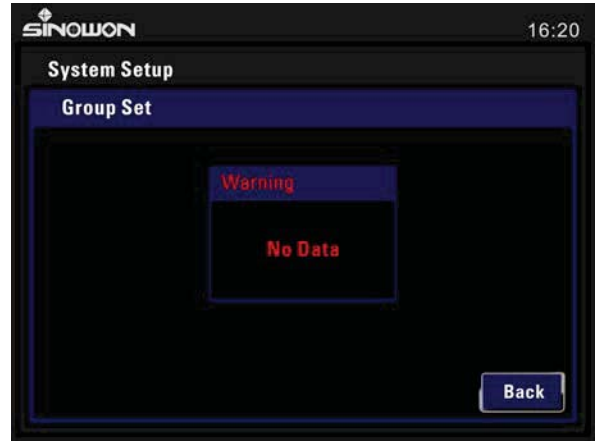


Fig 5-14 Group Data

5.5 Hardness Correction

The accuracy of the displaying hardness value was calibrated before leaving factory. If a tolerance is caused due to the transportation, the operator may regulate it based on the understanding of the instrument structure and principle. The method is as follows:

Method1, Remove the Upper Cover.

If the displaying value is inferior to the hardness value of standard hardness block, fix the M4 Screw Rod with a screwdriver and unscrew the nut a little and rotate clockwise forward Screw a bit (half a circle is about 1 degree higher); and then fix the Screw Rod and fasten the nut. Do the test and display value until the value stands in the tolerance range. If the displaying value is higher than the hardness value of the standard hardness block, rotate the Screw in the opposite direction. (There are screwdriver and spanner in accessories kit)

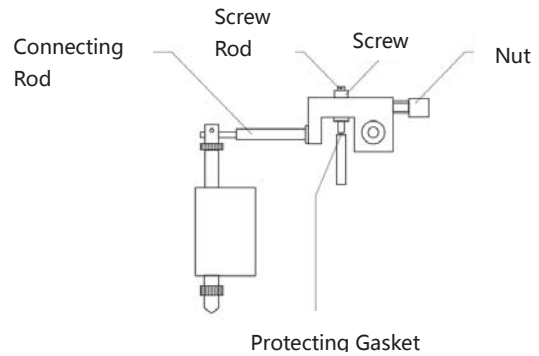


Fig 5-15 Tester Part illustration

Method2, System Correction

- On Fig5-1, click Correction to open this function (Fig5-16), this function only can modify current scale, If result higher than nominal value, click downwards arrow modify to negative value. Otherwise, modify to positive value. Note if one indenter correct while the others not, then check indenter may be damaged.

5.6 System Recovery

- Default setup will delete test setup, system setup and test results, if no special case, please do not use this function. Password 88888888.
- Steps: Enter system setup, select default setup, then enter password, click Enter on lower right corner, then system starts default setup (Fig 5-17), a moment later system will back to system setup.



Fig 5-16 System Correction



Fig 5-17 System Recovery

6. Maintenance

6.1 Attention During Operation

- 6.1.1 The operator should observe the operation regulations and calibrate the instrument with the standard hardness block before and after the test. If the tester is rarely used, the several tests should be carried out to make the tester stable after start the instrument and then carry out the necessary tests.
- 6.1.2 Gently rotate lifting anvil when load initial force and unloading initial force.
- 6.1.3 During the hardness test, when the loading and unloading of the test force or the keep of the dwell time is being carried out, it is prohibited to turn the Load-Change Hand Wheel.
- 6.1.4 The standard hardness block should be used only on the working plane with the distance of the two neighboring indentations and distance of the center of the indentations to their edges are not inferior to 3 mm. The life time of the hardness blocks is 2 years.
- 6.1.5 Before the transportation of the tester, the Connecting Rod should be fixed, and the Weights and the Hanging Rod should be discharged. Disconnect the power source before the Weights and the Hanging Rod are taken out.

6.2 Maintenance

- 6.2.1 Keep the tester clean and cover the tester with anti-dust bag after the test, lubricate the standard hardness blocks and ball indenters with the rust protecting oil to avoid rust.
- 6.2.2 Carry out periodic inspection of the tester, at least once a year in order to assure the correct operation of the tester.
- 6.2.3 Periodically add some lubricant on lead screw and inside of force knob.

6.3 Trouble Shooting

- 6.3.1 When the test is in the un-working state, it is advisable to get in touch with the relative units for the repair. The normal and common problems should be dealt with by your self (Table 3).

Table 3

Phenomenon	Possible Causes	Method Used
When the tester is switched on, the screen is not lit up	1 The current is blocked 2 The fuse is broken.	1 Check the power cable. 2 Change the fuse.
When the tester is on, the keys do not work	The instrument is not in working state.	When the tester is turned on, wait for a while until the instrument returns to the working state automatically.
The Up and Down Lead Screw is blocked	The space between the Up and Down Lead Screws is too small and they are blocked by the thread ends or feculence.	Remove the protecting cover of the Up and Down Lead Screw and clean the screw threads and than hold handle of Rotating Wheel with two hands up and down to pull the Up and Down Lead Screw (It is prohibited to rub the Up and Down Lead Screw with abrasive paper)

<p>The deviation of the displaying hardness value is too great.</p>	<ol style="list-style-type: none"> 1 The indenter is damaged. 2 The Weights are not installed in order. 3 The tester is not placed in the horizontal level and the weights touch the inside wall of instrument body. 4 The total test force or the indenter is wrongly chosen. 5 The protecting cover of Up and Down Lead Screw is high over the supporting plane of the Testing Table. 	<ol style="list-style-type: none"> 1 Change the diamond indenter or the ball indenter. 2 Install the weights according to Fig.3 3 Calibrate the tester with a level according to section 3.2.3 4 Select the testing force and the indenter according to the requirements in Table 1. 5 Lower down the protecting cover of the Up and Down Lead Screw.
<p>Touch screen unable</p>	<p>Under testing</p>	<p>Unload test force, then touch screen.</p>

7. Repairing

- Two years warranty for main unit only for quality problem, the others accessories are not under warranty. Refer packing list of ultrasonic hardness tester.
- Please show invoice and warranty card in case need repair.

8. Inspection Period

- Verification duration is 1 year, means each year the hardness tester need to be verified by legal metrology lab.

9. Shipping and Storage Notice

- Storage should be far away from the vibration, corrosion, moisture, dust, also should be stored at a normal temperature and humidity. Please put in the original packing box before transportation to avoid any damage.
- ◆ **Note:** Operation manual will be updated without further notice, latest edition will be sent to customers by email timely.

Annex 1 Hardness Value Corrections With Testing On Convex Cylindrical Surfaces

Corrections to be Added to Rockwell C, A, and D Values Obtained on Convex Cylindrical Surfaces of Various Diameters⁴

Dial Reading	Diameters of Convex Cylindrical Surfaces								
	¼ in. (6.4 mm)	⅜ in. (10 mm)	½ in. (13 mm)	⅝ in. (16 mm)	¾ in. (19 mm)	⅞ in. (22 mm)	1 in. (25 mm)	1¼ in. (32 mm)	1½ in. (38 mm)
	Corrections to be Added to Rockwell C, A, and D Values ⁵								
20	6.0	4.5	3.5	2.5	2.0	1.5	1.5	1.0	1.0
25	5.5	4.0	3.0	2.5	2.0	1.5	1.0	1.0	1.0
30	5.0	3.5	2.5	2.0	1.5	1.5	1.0	1.0	0.5
35	4.0	3.0	2.0	1.5	1.5	1.0	1.0	0.5	0.5
40	3.5	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

⁴ When testing cylindrical specimens, the accuracy of the test will be seriously affected by alignment of elevating screw, V-anvil, indenters, surface finish, and the straightness of the cylinder.

⁵ These corrections are approximate only and represent the averages to the nearest 0.5 Rockwell number, of numerous actual observations.

Corrections to be Added to Rockwell B, F, and G Values Obtained on Convex Cylindrical Surfaces of Various Diameters⁴

Hardness Reading	Diameters of Convex Cylindrical Surfaces						
	¼ in. (6.4 mm)	⅜ in. (10 mm)	½ in. (13 mm)	⅝ in. (16 mm)	¾ in. (19 mm)	⅞ in. (22 mm)	1 in. (25 mm)
	Corrections to be Added to Rockwell B, F, and G Values ⁵						
0	12.5	8.5	6.5	5.5	4.5	3.5	3.0
10	12.0	8.0	6.0	5.0	4.0	3.5	3.0
20	11.0	7.5	5.5	4.5	4.0	3.5	3.0
30	10.0	6.5	5.0	4.5	3.5	3.0	2.5
40	9.0	6.0	4.5	4.0	3.0	2.5	2.5
50	8.0	5.5	4.0	3.5	3.0	2.5	2.0
60	7.0	5.0	3.5	3.0	2.5	2.0	2.0
70	6.0	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

⁴ When testing cylindrical specimens, the accuracy of the test will be seriously affected by alignment of elevating screw, V-anvil, indenters, surface finish, and the straightness of the cylinder.

⁵ These corrections are approximate only and represent the averages to the nearest 0.5 Rockwell number, of numerous actual observations.

Annex 2 Allowable Repeatability and Error Table

Hardness Scales	Hardness Range	Permitted Error
HRA	(20 ~ 75)HRA	±2HRA
	(> 75 ~ 88)HRA	±1.5HRA
HRB	(20 ~ 45)HRB	±4HRB
	(> 45 ~ 80)HRB	±3HRB
	(> 80 ~ 100)HRB	±2HRB
HRC	(20 ~ 70)HRC	±1.5HRC
HRD	(40 ~ 70)HRD	±2HRD
	(> 70 ~ 77)HRD	±1.5HRD
	(> 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
HRE	(70 ~ 90)HRE	±2.5HRE
HRL	(100 ~ 120)HRL	±1.2HRL
HRM	(85 ~ 110)HRM	±1.5HRM
HRR	(114 ~ 125)HRR	±1.2HRR
HRN	--	±2HRN
HRT	--	±3HRT

Application Range Table

Scale Symbol	Indenter	Total Test Force, kgf	Typical Applications of Scales
B	1/16-in. (1.588-mm) ball	100	Copper alloys, soft steels, aluminum alloys, malleable iron, etc. Steel, hard cast irons, pearlitic malleable iron, titanium, deep case hardened steel, and other materials harder than B100.
C	diamond	150	
A	diamond	60	Cemented carbides, thin steel, and shallow case-hardened steel. Thin steel and medium case hardened steel, and pearlitic malleable iron.
D	diamond	100	
E	1/8-in. (3.175-mm) ball	100	Cast iron, aluminum and magnesium alloys, bearing metals. Annealed copper alloys, thin soft sheet metals.
F	1/16-in. (1.588-mm) ball	60	
G	1/16-in. (1.588-mm) ball	150	Malleable irons, copper-nickel-zinc and cupro-nickel alloys. Upper limit G92 to avoid possible flattening of ball. Aluminum, zinc, lead.
H	1/8-in. (3.175-mm) ball	60	
K	1/8-in. (3.175-mm) ball	150	Bearing metals and other very soft or thin materials. Use smallest ball and heaviest load that does not give anvil effect.
L	1/4-in. (6.350-mm) ball	60	
M	1/4-in. (6.350-mm) ball	100	
P	1/4-in. (6.350-mm) ball	150	
R	1/2-in. (12.70-mm) ball	60	
S	1/2-in. (12.70-mm) ball	100	
V	1/2-in. (12.70-mm) ball	150	



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