

Digital Universal Hardness tester

SHR-187.5D

Instruction Manual



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I . Precautions

1. Carefully read the Instruction Manual before you use the present instrument and get to know thoroughly the operation procedure and the usage precautions so as to avoid the damages to the instrument and the safety accidents caused by the improper operation.
2. All the bands and the anti-shock tapes should be carefully removed before the instrument is installed and calibrated.
3. The single-phase 3-pin socket should be used for the power source 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 this instrument. Otherwise the instrument will be caused accident.
5. It is to be avoided to turn the Load-change Hand Wheel or the Rotating Wheel during the loading and unloading operations and the dwell time of the test force.
6. Our company tries to improve the quality of the hardness testers and renew their structure. In case the contents in the INSTRUCTION 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.

II . Brief Introduction

1. Hardness is one of the important mechanic characteristics of the material 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 mechanic characteristics, and so its mechanic characteristics such as the strength, tiredness, wriggling and wearing out can be tested out approximately through its hardness testing.
2. Digital multi-functional hardness tester with Brinell, Rockwell, Vickers three testing methods, multi-functional hardness tester of seven grade test force, it can meet the needs of a variety of hardness tests. Test force loading, dwell, unload adopted automatic switching mechanism, test force transformation obtained by the rotation of hand wheel, indentation measured by precision encoder and sensor and calculated the hardness value by the internal system program. So it is easy to operate, fast and intuitive interface, basically, no human operation error, with its high sensitivity, stability, it is suitable for workshops and laboratories.

The main function as follows:

- 1.2 Brinell, Rockwell, Vickers three testing methods;
- 1.3 Conversion of different hardness scales
- 1.4 Selection of dwell time
- 1.5 Modifications of time and date
- 1.6 Output of testing results
- 1.7 RS232 interface for optional functions, this model can save testing results and browse testing pages.

III . Technical specifications

Table 3-1

Specification	SHR-187.5D
Rockwell Scales	HRA; HRB; HRC; HRD
Rockwell Testing Force	60kgf (588.4N) ; 100kgf (980.7N) ; 150kgf (1471N)
Brinell Scales	HBW1/30; HBW2.5/31.25; HBW2.5/62.5; HBW5/62.5; HBW10/100; HBW2.5/187.5
Brinell Testing Force	31.25kgf (306.5N) ; 62.5kgf (612.9N); 100kgf (980.7N) ; 187.5kgf (1839N)
Vickers Scales	HV30,HV100
Vickers Testing Force	30kgf (294.2N) ,100kgf (980.7N)
Rockwell Hardness Indication	Digital Display
Rockwell Hardness Resolution	0.1HR
Brinell Indention Reading	37.5× Measuring microscope (15× eyepiece and 2.5× objective) 75× Measuring Microscope (15× eyepiece and 5× objective)
Brinell Value Reading	Digital Display
Vickers Indention Reading	75×Measuring Microscope(15×eyepiece and 5× objective)
Vickers Value Reading	Digital Display
Dwell Time	Adjustable 0~60s
Max.Height of Specimen	Rockwell: 175mm; Brinell: 100mm Vickers: 115mm
Instrument Throat	165mm
Dimension (L×W×H)	551× 260 × 800mm
Plywood Packing Dimension	655 × 385×1000mm
Gross/Net Weight	105/80kg
Power Supply	AC220V±5%, 50~60Hz
Accuracy	Conform to ASTM E-18; ISO6508; EN-ISO6507

IV. Installation of the Hardness Tester

1. The working condition of the tester

- 1.1 Under the room temperature, between 10~30°C ;
- 1.2 The relative humidity in the test room shall not be over 65%;
- 1.3 In an environment free from vibration;
- 1.4 Without corrosive agent in surroundings.

2. The unpacking of the Tester

- 2.1 Loosen off 4 nuts from the bottom of the packing box; hold up and move off packing box, then take out accessories kit.
- 2.2 Lift the bottom plate and unscrew the two M10 bolts under bottom plate with a spanner to separate the hardness tester from the bottom plate (take care of the safety).
- 2.3 After unpacking, the tester shall be placed on a stable bench with horizontal deviation less than 1 mm/m. A hole shall be drilled at an appropriate location on the bench (see Fig .4-1) to enable the Up and Down Moving Shaft (7) to operate properly.
- 2.4 Take out 4 level screw and install them the bottom side of machine.

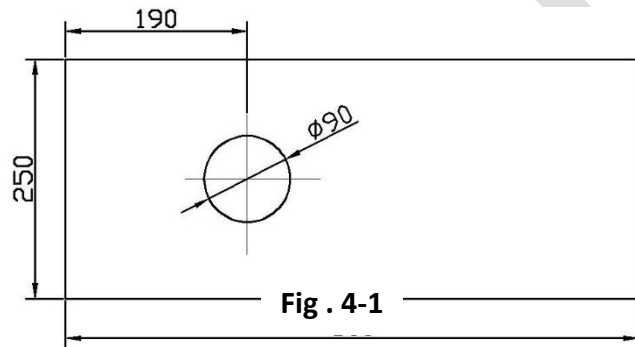


Fig . 4-1

2.5 Take out lever on the machine adjust the leveling.

to

1. LCD Display

2. The Touch Panel

3. The Fastening Screw for the indenter

4. The Indenter

5. The Working Table

6. Upper and Down Moving

7. The Rotating Wheel

8. Level Screw

9. Upper cover

10. Back cover

11. Socket

12. Frame of Microscope

13. Force Knob

14. Power Switch

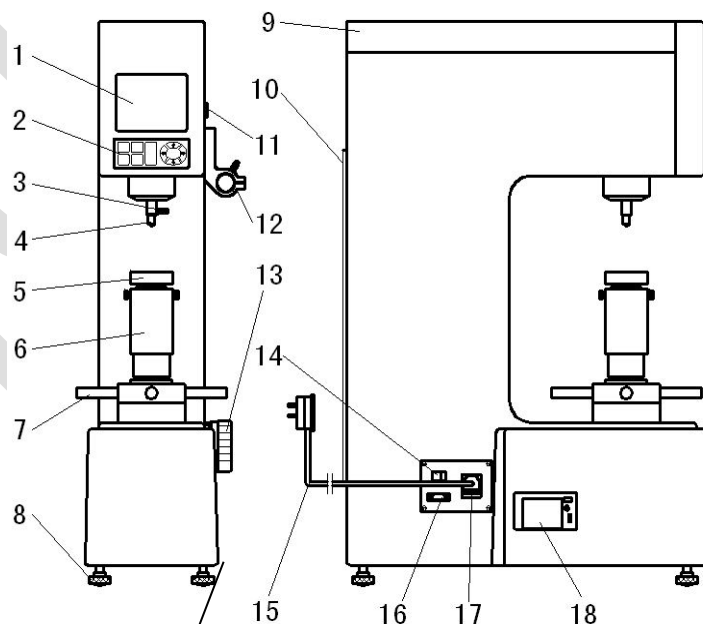
15. Power Cable

16. RS232 Socket

17. Fuse

18. Printer

19. Emergency Stop Button



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Fig . 4-2

Shaft

3. The installation of the tester (see Fig. 4-2)

Uncover upper and back cover, take out the fastening rubber tape and all the white gauzes on moving parts and then recover the tester to keep away dust.

4. The Installation of the Weight Group (Fig.4-3)

4.1 Take the weight group out of the accessories kit and clean them thoroughly.

4.2 Rotate force knob to “306.5 (31.25)”, put the weight 4, weight 3, weight 2 and weight 1 on the holder one by one.

4.3 Weight 0 should be put on the upper place of the hanging rod (when test force is 294.2N (30kg), the Weight 0 should be removed off).

4.4 After that, rotate the load-change hand wheel clockwise for a whole cycle and observe.

4.5 The weights should not touch any components when they are impending on. (Note: firstly, put the level instrument on the working table to adjust the levelness for the hardness tester). Cover the up and back cover.

- | | | |
|-----------------------|--------------|--------------|
| 19. “0” Weight | 20. Rod | 21. Weight 1 |
| 22. Fork shaped frame | 23. Weight 2 | 24. Weight 3 |
| 25. Holder | 26. Weight 4 | 27. Weight 5 |

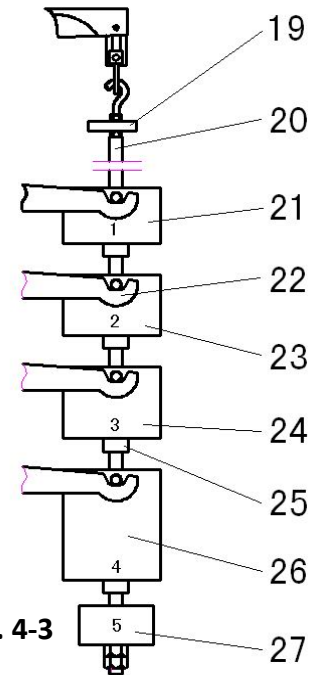


Fig. 4-3

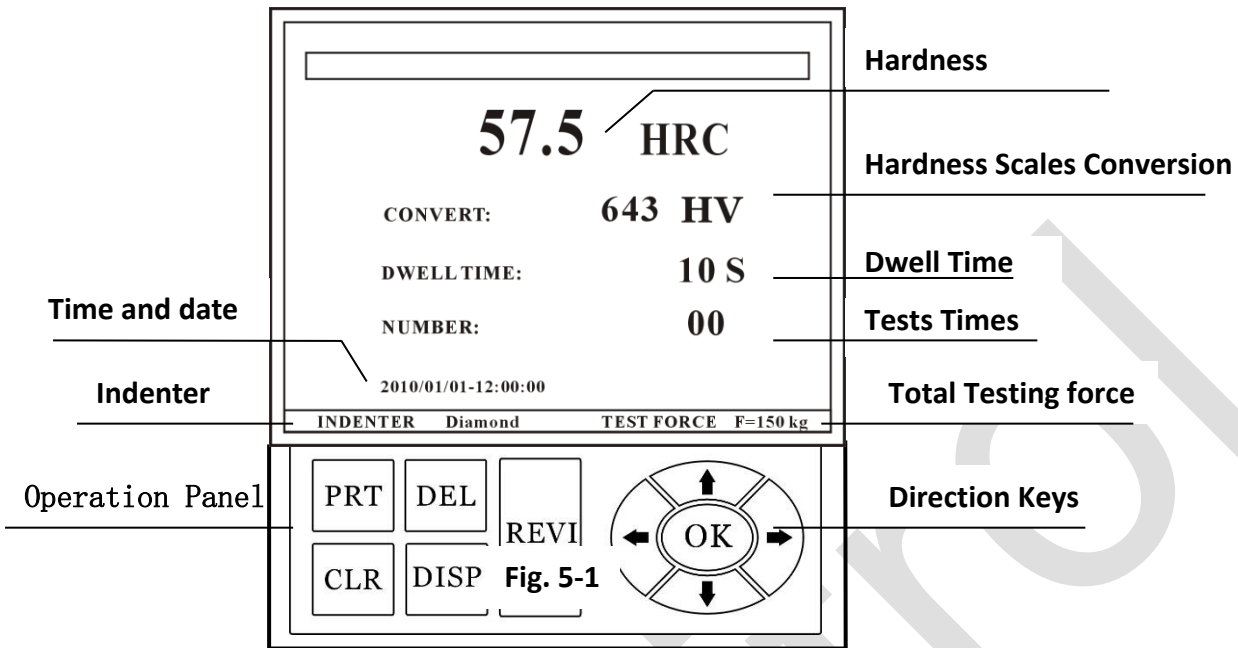
5. Hardness yardstick - test force - weights relations (Table 4-1).

Table 4-1

Hardness Scale	Test Force	Force Knob	Force on the Weight (Weight Code)	Remark
HV,HB	294.2N(30kg)	306.5	Weight5	Remove Weight 0
HB	306.5N(31.25kg)	306.5	Weight5+Weight0	Put back Weight0 to original place
HRA	588.4N(60kg)	588.4	Weight5+Weight0+Weight1	
HB	612.9N(62.5kg)	612.9	Weight5+Weight0+Weight2	
HV,HB, HRB	980.7N(100kg)	980.7	Weight5+Weight0+Weight2+Weight 3	
HRC	1471N(150kg)	1471	Weight5+Weight0+Weight1+Weight 2 +Weight4	
HB	1839N(187.5kg)	1839	Weight5+Weight0+Weight1+Weight 2 +Weight3+Weight4	

V. Introduction of Control Panel

1. Connect the Power Socket with power source, then turn on The Switch, main interface as follows:



2. <REVI> Function Key

System setting menu, press this key, LCD will display 5 (Fig. 5-2) items, press direction key to select and press OK to confirm, press Exit for back to main page.

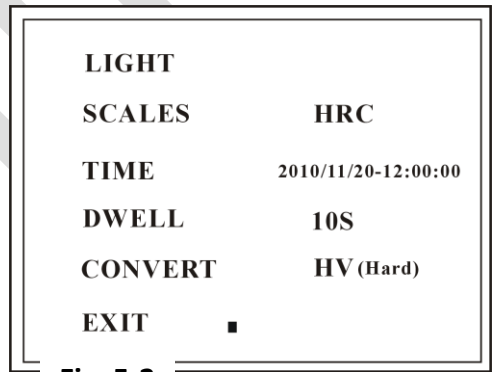


Fig. 5-2

2.1 SCALES: (Hardness Scales Conversions)

Press <REVI>Enter system setting, Press direction key and select Scales, then press OK enter Hardness Scales table. The table includes:

- A) 4- Rockwell Scales;
- B) 6- Brinell Scales;
- C) 2- Vickers Scales.

Press direction keys to select the hardness scales, press OK to save setting and back to main page. Turn off the machine can save settings (Fig. 5-3) .

Rockwell Brinell Vickers Hardness Tester						
Rockwell(HR)	HRA	HRD	HRC	HRB		
Brinell(HB)	1.0/ 30	2.5/ 31.25	2.5/ 62.5	2.5/ 187.5	5.0/ 62.5	10/ 100
Vickers(HV)	HV30	HV100				
UP DOWN LEFT RIGHT OK KEY						

Fig. 5-3

2.2 TIME:

Operation step is same, press direction key to modify time and date, then press OK to confirm and save setting.

2.3 DWELL: (Dwell time)

Press direction key to adjust dwell time and press OK to confirm and save settings.

2.4 CONVERT: (Conversion of Hardness Scales)

Same as last step to enter system setting, then press OK into conversion (Fig. 5-4) . Press direction key to select hardness scales and confirm by OK and save settings.

- HARD is for black metal.
- SOFT is for soft metal.

HARD		SOFT	
HV ■	HRD	HRF	45T
HRC	15N	HRG	HBW
HK	30N	HRE	HV
HBW	45N	HRK	HK
HRA	HS	15T	HS
HRB		30T	HRB

UP DOWN OK KEY

Fig. 5-4

2.5 LIGHT: (Lightness Adjustment)

Same as entering system setting menu, press OK to enter lightness setting, press direction key to adjust (Fig. 5-5) , upper key is more lightness while lower key is reduce lightness. IN LED is for Vickers hardness OUT LED is for Brinell Press OK to confirm and save settings.

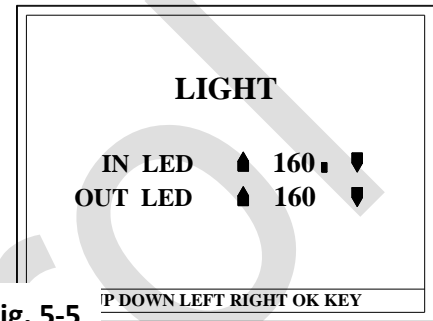


Fig. 5-5

2.6 Others Function Keys

- PRT** — Printing key, when testing times more than 2, print this key output date.
- CLR** — Zero clearing key, press this key display hardness value is 0, when test Brinell and Vickers, this key is for zero clearing the diameters.
- DEL** — Deleted the hardness testing value.
- DISP** — Display key, when testing times more than 2, press this key to show the current hardness value and press REVI back to home page. The page you can save is up to 6 (00 page ~ 05 page), when you want to save the 7th page, it will automatically overflow the first page. Turn off machine will make the saved data disappear.
- OK** — Confirmation Key.

- Direction key, used to select the menu.
- Direction key, used to select the menu.

VI. Rockwell Hardness

1. Specifications of Rockwell Hardness (Table 6-1)

Table 6-1

Testing force (N)	Initial Testing Force	98.07 (10kg)			Tolerance ±2.0%
	Total testing force	588.4 (60kg)			Tolerance ±1.0%
		980.7 (100kg)			
		1471 (150kg)			
Indenter	Diamond Cone Indenter				
	Φ1.5875mm Ball Indenter				
Scales	HRA	HRB	HRC	HRD	
Max height of samples	175mm				

2 The Scale, Indenter, Testing Force and Application Fields of the Rockwell Hardness Test (Table 6-2)

Table 6-2

Scales	Indenters	Initial Testing force (N)	Total Testing force (N)	Applications
HRA	Diamond Cone Indenter	98.07	588.4	Hard alloy, carbide, surface-quenched steel, carburized steel plate (sheet)
HRD			980.7	Thin Steel sheet, surface-quenched steel
HRC			1471	Quenched steel, tempered steel, Hard cast iron
HRB	Ball Indenters Φ 1.5875mm (1/16 inch)		980.7	Mild steel, aluminum alloy, copper alloy, malleable cast iron, annealed steel

Scale A,B,C are the common use for Rockwell hardness test

3. The Tolerance of Rockwell Hardness Display Value (Table 6-3)

Table 6-3

Hardness Scale	Hardness Range of The Standard Testing Blocks	The Max. Tolerance of Display Value	Repeatability ^a						
HRA	(20~75) HRA	±2HRA	≤0.02 (100-H) or 0.8 Rockwell Unit ^b						
	(>75~88) HRA	±1.5HRA							
HRB	(20~45) HRB	±4HRB	≤0.04 (130-H) or 1.2 Rockwell Unit ^b						
	(>45~80) HRB	±3HRB							
	(>80~100) HRB	±2HRB							
HRC	(20~70) HRC	±1.5HRC	≤0.02 (100-H) or 0.8 Rockwell Unit ^b						
HRD	(40~70) HRD	±2HRD	≤0.02 (100-H) or 0.8 Rockwell Unit ^b						
	(>70~77) HRD	±1.5HRD							
a: H is average hardness value b: Confirm as higher value									
Hardness Value	Diameter of the Cylindrical Specimen (mm)								
	6	10	13	16	19	22	25	32	38
	Adjusted Value (HR) by Rockwell Scales A. C. D.								

4. Correct Use of Hardness Tester

Preparations before testing

- 4.1 The surface of the specimen should be smooth and clean without any feculence, oxidized peels and concaves, on the outstanding without processing signs.
- 4.2 The specimen should be stably fixed on the working table. There should be no any movement of the specimen during the testing process and the test force should be loaded perpendicularly on the specimen.
- 4.3 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.

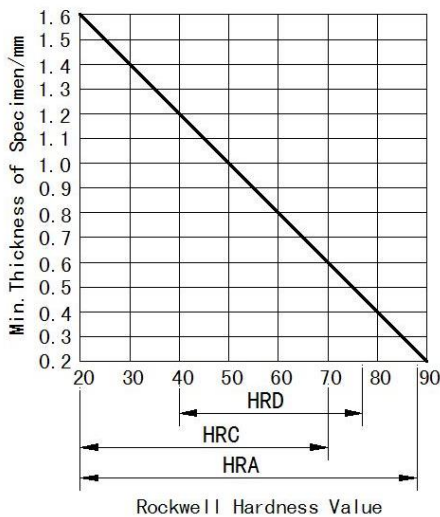
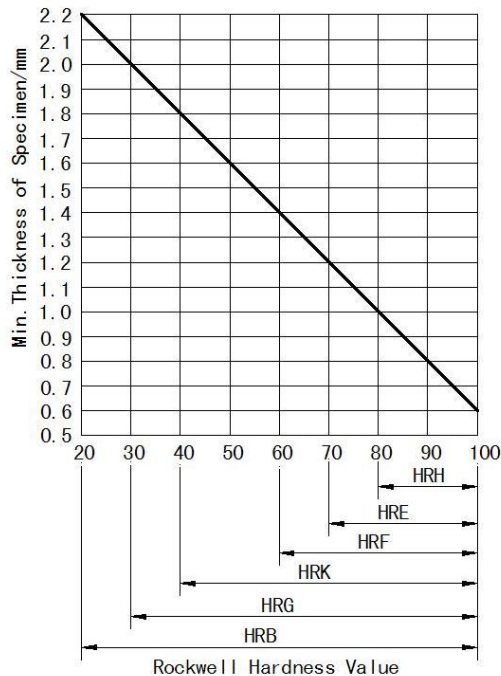


Fig. 6-1



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 the Cylindrical Specimen (mm)								
	6	10	13	16	19	22	25		
Adjusted Value (HR) by Rockwell Scales A. C. D.									
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	

Table 6-4

4.4 When the specimen is columned in shape, the V-shaped testing table must be used. When testing HRC or HRA hardness value, the diameter of the specimen is smaller than 38 mm and when testing HRB hardness value, the diameter of specimen is smaller than 25 mm, the results of the test should be revised. The revised values are all positive numbers. (Table 6-4)

5. The Operation Procedure of the Rockwell Hardness Testing

5.1 Refer table 6-2, select correct indenter and testing force according to scales, rotate force knob to needed testing force.

- 5.2 Push the indenter into the hole of main spindle closely against the supporting plane and make the caved plane of the indenter handle face to the screw. Fasten slightly the Fastening Screw for the Indenter, take the working plate (large, small flat working plate or V shape) out of the accessory kit and then place the specimen on the Working Table.
- 5.3 Press “REVI”, display option menu (Fig.5-2)
- 5.4 Press UP-DOWN key select “SCALES”, press OK, displays Brienll, Rockwell, Vickers scales, select the required scale and press OK back to main page.
- 5.5 Refer chapter 5.1.2~5.1.4, select Hardness scale conversion and dwell time.
- 5.6 Turn the Rotating Wheel clockwise, lift the Up and Down Moving Shaft, enable the specimen slowly touch the indenter without any shock until the beeped for hint (If the set value exceeded, hardness tester will beep an error automatically and stop working. it should go back, then, it should be screwed down, and change for another point to restart.)
- 5.7 Start the motor and loading, dwell time is 5 seconds, then countdown to 0.
- 5.8 Unloading testing force and keep initial testing force, Beep sound, you can read the hardness value.
- 5.9 Counter-clockwise rotate, descend test anvil and move sample, repeat above operation.
- 5.10 The number of the point to be tested is not less than 5 (the first point is not counted in the system.) The number of the points to be tested may be reduced a bit for the specimen tested in a serial.
- 5.11 Press “PRT” to print the testing value.

6. The Rockwell Hardness Value Regulated (Fig 6-2)

The precision of the displayed hardness value is calibrated before the instrument leaving factory. If tolerance is caused due to the transportation, the operator can calibrate it based on the understanding of the instrument structure and principle. The method is as follows: Remove the Upper Cover. If the value displayed in inferior to the value of standard block, fix the M4 Screw Rod with a screw piece and unscrew the nut a little and rotate Screw clockwise a bit (half a circle is about 1 degree hardness value higher); regulate the Zero position for the dial indicator 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 displayed value is higher than the hardness value of the standard block, rotate the Screw in the opposite direction. (There are screw plate and wooden hand in the accessory box.)

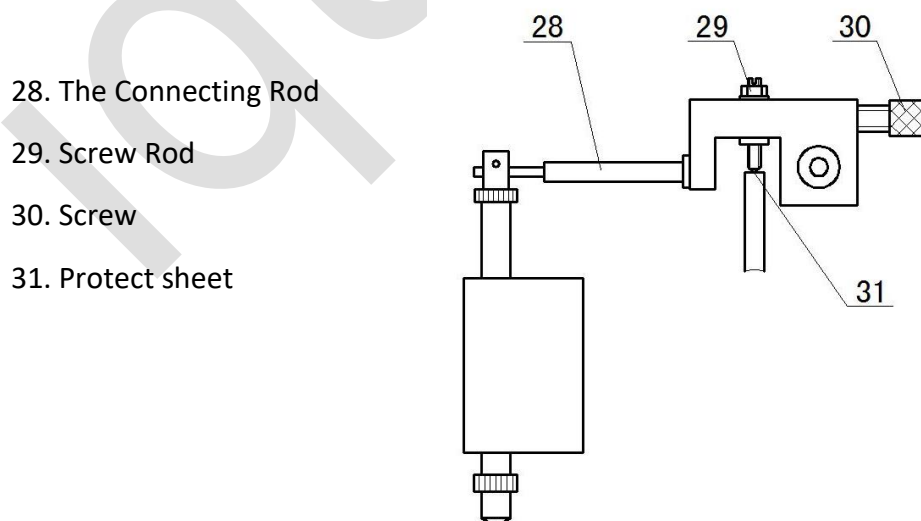


Fig. 6-2

VII. Brinell hardness

1. The Technical Specification of Brinell Hardness Tester (Table 7-1)

Table 7-1

Testing force	294.2N (30kg)			Tolerance $\pm 1.0\%$
	306.5N (31.25kg)			
	612.9N (62.5kg)			
	980.7N (100kg)			
	1839N (187.5kg)			
Indenter	ϕ 2.5mm、 ϕ 5mm Ball Indenter			
Scales	HBW1/30	HBW2.5/31.25	HBW2.5/62.5	
	HBW5/62.5	HBW10/100	HBW2.5/187.5	
Eyepiece magnification	15 ^x			
Objective	2.5 ^x (resolution 0.5 μ m)、5 ^x (resolution 0.25 μ m)			
Max Height of Sample	100mm			

2. The Tolerance and Repetition of Displayed Value for Brinell Hardness Tester (Table 7-2)
3. Table of Brinell Hardness Testing Scales, Indenters, Testing Forces and Range (Table 7-3)
4. According to materials and Brinell Hardness value select 0.102F/D2 (Table 7-4)

Table 7-2

Hardness Block (HBW)	Tolerance (%)	Repeatability (%)
≤ 125	± 3	3
$125 < \text{HBW} \leq 225$	± 2.5	2.5
> 225	± 2	2

Table 7-3

Sign	Diameter D(mm)	Testing Force F	0.102 F/D ²	Indenter Diameter (mm)	Hardness Range (HBW)	Objective
HBW 10/100	10	980.7N (100kg)	1	2.4~6	21.8~3.8	2.5 ^x
HBW 5/62.5	5	612.9N (62.5kg)	2.5	1.2~3	54.5~8	2.5 ^x 5 ^x
HBW 2.5/187.5	2.5	1839N (187.5kg)	30	0.6~1.5	653~95	
HBW 2.5/62.5	2.5	612.9N (62.5kg)	10	0.6~1.5	218~32	5 ^x
HBW 2.5/31.25	2.5	306.5N (31.25kg)	5	0.6~1.5	109~16	
HBW 1/30	1	294.2N (30kg)	30	0.24~0.6	653~95	

Testing force should let the indentation diameter at the range of $0.25D < d < 0.6D$, when $d=0.37D$, the hardness value is exactly (d =indentation diameter, D =indenter diameter)

Table7-4

Materials	Brinell Hardness Value	0.102F/D ²
Steel, nickel alloy, titanium alloy	—	30
cast iron	<140	10
	≥140	30
Copper, copper alloy	<35	5
	35~130	10
	>130	30
Soft Metal	35	2.5
	35~80	5 或 10
	>80	10

F—Testing force (N) D—Diameter of Ball Indenter (mm)

5. Installation of Microscope and Moveable Anvil

5.1 Take out the moveable anvil and rub-up antirust oil, install the moveable anvil and circumrotate the locknut (Fig.7-1) ;

5.2 Insert microscope socket in the right of microscope frame, make sure microscope stand upright with test table and fasten screw;

5.3 Insert eyepiece, then insert 5^x (2.5^x) objective under microscope stand, outside light should be

installed according to below picture, cable should be inserted right socket of machine.

5.4 Take out the outside light and install it according to the diagram and fix the screws. Connect the cable to the socket of right side of the machine. (Choose the inside light under Vickers measuring, also use this socket.)

- 32. Eyepiece
- 33. Right drum
- 34. Stand of microscope
- 35. Outside light (Brinell)
- 36. Objective
- 37. Moveable test anvil
- 38. Fasten screw
- 39. Out ward off pin
- 40. In ward off pin
- 41. Inside light (Vickers)
- 42. Screw
- 43. Input button

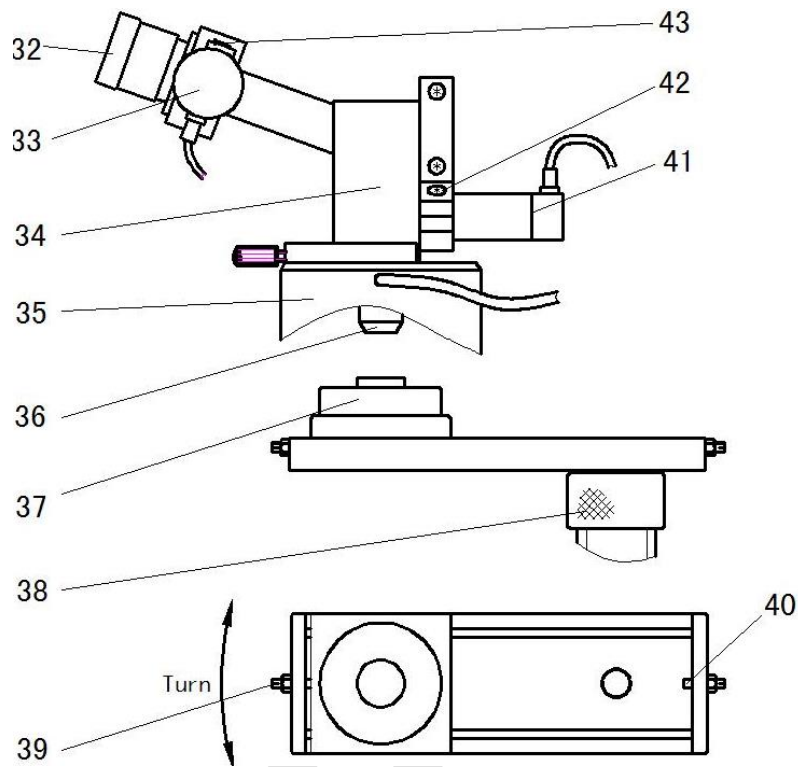


Fig. 7-1

- 6. Usage of brinell hardness testing
 - 6.1 Power on and switch on, LCD display.
 - 6.2 Press "REVI", display optional menu (Fig.5-3) .
 - 6.3 Press Up-Down key, select "SCALES" and Press OK, displays Brinell, Rockwell and Vickers hardness scales, then select Brinell scale and outside light. (Fig.7-2) .

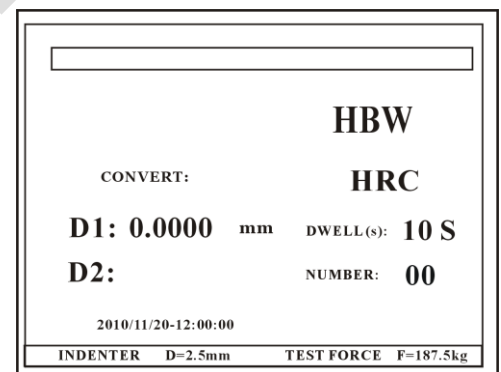


Fig. 7-2

7. Operation Steps of Brinell hardness testing

For example: 2.5^x objective, Ball indenter is Dia 2.5mm, testing force is 1839N (187.5kg) to test Brinell hardness value.

- 7.1 Rotate force knob to 1839N (187.5kg) .
- 7.2 Push the 2.5mm indenter into the hole of main spindle closely against the supporting plane and make the caved plane of the indenter handle face to the screw. Fasten slightly the Fastening Screw for the Indenter, take the working plate (large, small flat working plate or V shape) out of the accessory kit and then place the specimen on the Working Table.
- 7.3 Put sample on the test anvil, move to indenter and near inside ward off pin.
- 7.4 Read Chapter V . (clause 2.2~2.4) , separately select conversion among scales and dwell time.
- 7.5 Turn the Rotating Wheel clockwise, lift the Up and Down Moving Shaft, enable the specimen slowly touch the indenter without any shock until the beeped for hint (If the set value exceeded, hardness tester will beep an error automatically and stop working. it should go back, then, it should be screwed down, and change for another point to restart.)
- 7.6 Start the motor and loading, dwell time is 5 seconds, then countdown to 0.

Note: Dwell time of Brinell: Black metal 10~15 seconds, non-ferrous metal 30~35 seconds, when

the hardness value below 35, dwell time is 60 seconds.

7.7 Unloading testing force and keep initial testing force by Beep sound.

7.8 Counter-clockwise rotate, descend test anvil. (For 2.5x objective, descend about 30mm, for 5x objective descend about 10mm) .

7.9 Move the anvil and sample below objective.

8. Measure diameter of indentation

8.1 Before measure diameter of indentation, rotate eyepiece drum and make sure the two lines clear (Fig. 7-2) .

8.2 As the center of screw, slowly rotate test anvil to seek indentation, and up down move anvil to get indentation and let it clear, then fasten screw.

8.3 Adjust lightness of field light, refer Chapter V . (2.5)

8.4 Rotate right drum to let two line closely until no gap, then press “CLR” (Fig.7-3) .



Zero correction with memory function, just adjust it when restart the machine or replace operators.

8.5 Rotate left drum, and make the left line with left edge indentation tangent (Fig 7-4).

8.6 Rotate right drum, and make the right line with right edge indentation tangent (Fig.7-5).

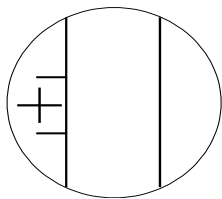


Fig .7-2

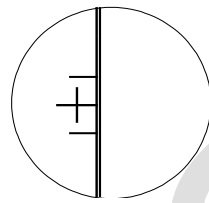


Fig.7-3

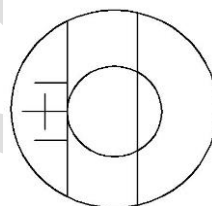


Fig.7-4

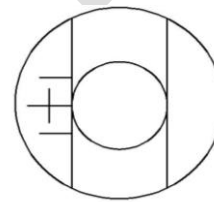


Fig .7-5

8.7 Press button on the eyepiece and there is D1 on display.

8.8 Rotate eyepiece 90° clock-wise, eyepiece should be pasted on tube of eyepiece without gap; otherwise it affects accuracy. Same press button on eyepiece get D2 on display. You can get HBW value on display and there is measuring times NO.1.

8.9 If you find there is error for this value, please press “DEL” to cancel this data and recheck D1 and D2.

8.10 When measurement more than 2, press “PRT” can print measuring data.

9. Brinell hardness Take Notes

9.1 The surface of specimen and the indenter shall be kept clean, any oil or dust may have impact on the accuracy of measurement. Use ether or ethanol to clean specimen and indenter.

9.2 Samples should be kept on anvil and avoid any movement, make sure indenter is uprightly impact on samples.

9.3 Diameter of indentation must be in the range of $0.25D < d < 0.6D$, when $d=0.375D$, the testing accuracy is excellent (d =diameter of indentation, D =diameter of ball indenter) .

9.4 The thickness of samples must be 10 times higher than depth of indentation, no trace on the back of samples Table7-5.

9.5 Tolerance of hardness tester is the ratio between differences of average value and standard hardness value and standard hardness value. Repeatability is the ratio between max difference and average hardness value. Tolerance and Repeatability conform Table 7-2.

Table7-5

The average diameter of indentation	Min. thickness of specimen			
	The diameter of ball			
	D=1	D=2.5	D=5	D=10
0.2	0.08			
0.3	0.18			
0.4	0.33			
0.5	0.54			
0.6	0.8	0.29		
0.7		0.4		
0.8		0.53		
0.9		0.67		
1		0.83		
1.1		1.02		
1.2		1.23	0.58	
1.3		1.46	0.69	
1.4		1.72	0.8	
1.5		2	0.92	
1.6			1.05	
1.7			1.19	
1.8			1.34	
1.9			1.5	
2			1.67	
2.2			2.04	
2.4			2.46	1.17
2.6			2.92	1.38
2.8			3.43	1.6
3			4	1.84
3.2				2.1
3.4				2.38
3.6				2.68
3.8				3
4				3.34
4.2				3.7
4.4				4.08
4.6				4.48
4.8				4.91
5				5.36
5.2				5.83
5.4				6.33
5.6				6.86
5.8				7.42
6				8

- 9.6 The minimum distance between center of dent and edge of specimen shall be 2.5 times of the average dent diameter. Pitch of two adjacent dents shall be at least 3 times of the average dent diameter.
- 9.7 Diameter shall be measured along two perpendicular axes, and their arithmetic average shall be taken as the test result.
- 9.8 The effective measuring range is 60% of eyepiece FOV.

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VIII. Vickers Hardness

1. Technical Specifications of Vickers Hardness (Table 8-1)

Table 8-1

Test force	294.2N (30kg)	Tolerance $\pm 1.0\%$
	980.7N (100kg)	
Indenter	Diamond Vickers Indenter	
Scale	HV30	HV100
Eyepiece magnification	15 ^x	
Objective magnification	5 ^x (Resolution 0.25 μ m)	
Max. Height of Specimen	115mm	

2. The Tolerance and Repetition of Displayed Value for Vickers Hardness Tester (Table 8-2)

Table 8-2

Tolerance of Displayed Value			Repetition of Displayed Value	
Hardness scale	Value of Hardness Block	Tolerance of Displayed Value	Value of Hardness Block	Repetition of Displayed Value
HV30 HV100	$\leq 250\text{HV}$	$\pm 3\%$	$\leq 225\text{HV}$	6%
	300~1000HV	$\pm 2\%$	$> 225\text{HV}$	4%

3. Usage of Vickers hardness

3.1 Press "REVI" key into the operation menu (Fig.5-2).

3.2 Press the arrow keys, select "SCALES" blinking cursor, press the "OK" button, the screen show the Brinell, Rockwell, Vickers hardness scale selection table (Fig.5-3). Select your desired hardness scale and Press "OK" button to return to the main page (Fig 8-1).

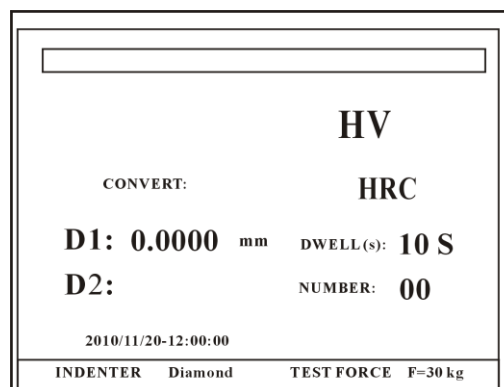


Fig. 8-1

4. The operation sequence of Vickers hardness

4.1 Please check the Chapter VII., section 5 for the installation of digital eyepiece and Slipped Testing Table.

4.2 Please check the chapter VII., section 7 for the operation of Vickers hardness. The main difference is that:

A The dwell time of black metal is 10~15 seconds and the dwell time of black metal is 30±2 seconds.

B The inside light should be used under Vickers measuring.

4.3 Please check the chapter VII., section 8 for the measurement operation of Vickers hardness indentation diagonal length.

5. Precautions of Vickers hardness

5.1 The surface of specimen and the indenter shall be kept clean, any oil or dust may have impact on the accuracy of measurement. Use ether or ethanol to clean specimen and indenter. The cleanliness can't be lower than 0.8.

5.2 Samples should be kept on anvil and avoid any movement, make sure indenter is uprightly impact on samples.

5.3 Diameter shall be measured along two perpendicular axes, and their arithmetic average shall be taken as the test result.

5.4 Tolerance of hardness tester is the ratio between differences of average value and standard hardness value and standard hardness value. Repeatability is the ratio between max difference and average hardness value. Tolerance and Repeatability conforms Table 8-2.

5.5 The effective measuring range is 60% of eyepiece FOV.

5.6 The thickness of samples must be 1.5 times higher than depth of indentation, no trace on the back of samples (Fig.8-2)

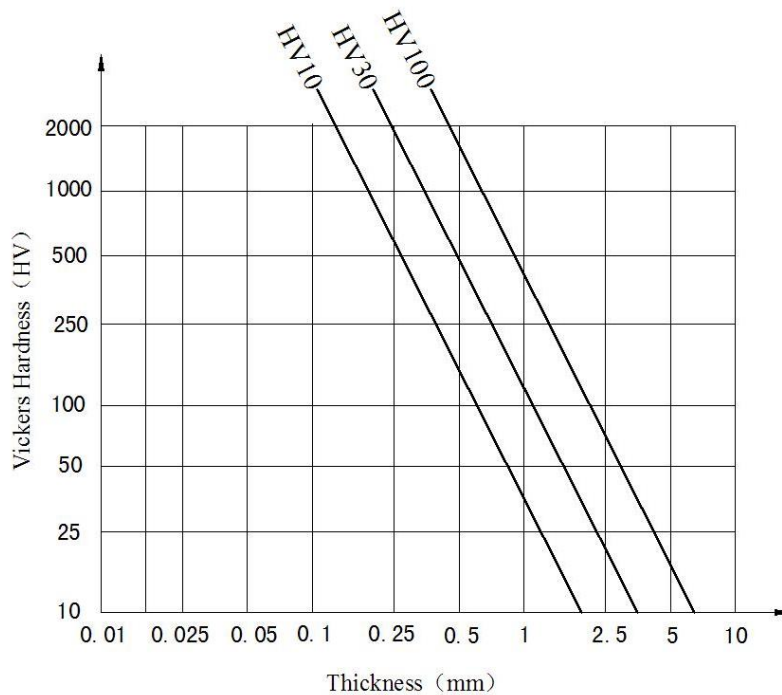


Fig. 8-2

IX. Maintenance and Precaution

1. The operator should observe the operation regulations and calibrate the instrument with the standard block before and after the test. If the tester is rarely used, the several tests should be carried out to make the tester stable and then carry out the necessary tests.
2. The hardness block should be used only on the working plane, and the life time of the hardness blocks is 2 years.
3. During the transportation of the tester, the tester should be fixed with the Connecting Rod, with the Weights and the Hanging Rod discharged. Disconnect the power source before the Weights and the Hanging Rod are taken out.
4. The accuracy of digital eyepiece has been adjusted at the factory, please don't disassemble.
5. The use and storage of measurement systems, should avoid dust, moisture and corrosive gases in the environment.
6. Digital eyepiece and objective application of the glass surface dirt soft cotton, lens cleaning paper to clean, grease contamination encountered, the available cotton wool dipped in alcohol or ether mixture a little graze.
7. Keep the tester clean and cover the tester after the use, lubricate the hardness blocks and ball indenters with the rust preventing oil.
8. Carry out periodic inspection of the tester, at least once a year in order to assure the correct operation of the tester.
9. The Treatment of the Common Malfunctions of the Tester 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 by one's self (Table 9-1). **Table 9-1**

Phenomenon	Possible Causes	Method Used
When the tester is on ,the nixie tube is not light up	1 The current is blocked. 2 The fuse is broken.	1 Control the power cable. 2 Change the fuse.
The long pointer is offset, not point to "C" position	After regulate the display value of hardness, it causes the long pointer offsets.	According to Fig.4, loosen the Nut on Screw Rod slightly, rotate the M4 Screw Rod a bit, enable the Dial aim to "C" position, then fix the screw, and fasten the Nut.
The Up and Down Moving Shaft road is blocked	The space between the screws is too small or they are blocked by the thread ends at dirt	Remove the protecting cover of the Up and Down Moving Shaft and clean the teeth of the gear and than held Rotating Wheel with two hands to pull the Shaft up and down.
The deviation of the display hardness value is too great.	1 The indenter is damaged 2 The protecting cover outside the Up and Down Moving Shaft touch with the Working Table . 3 The weights are not arranged in order. 4. The tester is not placed in the horizontal level, with the weights touch the inside wall of the instrument body. 5. The total test force or the indenter is wrongly chosen.	1 Change the diamond indenter or the ball indenter. 2 Lower down the protecting cover to let it lower than the upper plane of the Up and Down Moving Shaft, then fasten the screw. 3 Install the weights according to Fig.4-3 4 Calibrate the tester with a lever according to Item Table6-2 in Table 7-3 section of the Chapter III. 5 Select the tester force and the indenter according to the requirements

X. Accessories (Packing list)

Accessories Kit of Main Body

No.	Description of Goods	Quantity
1	Diamond Rockwell Indenter	1 PC
2	φ 1.5875mm Steel ball indenter	1 PC
3	Large Test Table, Medium Test Table, V-shaped Test Table	3 PCS
4	0、1、2、3、4 weight	5 PCS
5	Standard Hardness Block HRC (High, Lower) , Standard Hardness Block HRB	3 PCS
6	Level Regulation Screw	4 PCS
7	Screw driver, Spanner	2 PCS
8	Power cable	1 PC
9	Instruction Manual	1 PC
10	Plastic Anti-dust Bag	1 PC

Accessories Kit of Microscope

No.	Description of Goods	Quantity
1	Eyepiece	1 PC
2	Seat of Microscope	3 in all
3	Outside Light	
4	Inside Light	
5	2.5× objective	1 PC
6	5× objective	1 PC
7	Slipped Testing Table	1 PC
8	Diamond Vickers Indenter	1 PC
9	φ 2.5mm、 φ 5mm Ball Indenter	2 PCS
10	Standard Vickers Hardness Block (HV30)	1 PC
11	Standard Brinell Hardness Block (HBW/2.5/187.5)	1 PC
12	Level	1 PC
13	Fuse 2A	2 PCS

Our company also produces Metallurgical Equipment such as Metallurgical Sample Mounting Press, Metallurgical Sample Cutters and Metallurgical Sample Polishers, etc. Our products which can be divided in 5 classes, 10 kinds and over 40 specifications are the most idea and advanced metallurgical equipmenty among the same kinds products in China market and are warmly welcomed by our users.