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**ISH-R150
MANUAL ROCKWELL HARDNESS TESTER
OPERATION MANUAL**

Attention

- ◆ This Instruction Manual shall be carefully read through in prior to use of the apparatus to clearly understand the detailed operation steps and special notes, and avoid apparatus damage or personal injury caused by improper use.
- ◆ Fastening tapes and cushion materials shall be carefully removed before installation and calibration of the apparatus.
- ◆ Never rotate the pressure selecting hand-wheel or turn-wheel when applying, keeping or removing the testing pressure.
- ◆ We are making continuous renovation in design of the hardness tester to improve its performance. Small change may be found in apparatus design without notification.

Description

- ① ISH-R150 Rockwell Hardness Tester is an universalized apparatus for Rockwell hardness determination. It can be used in the test of Rockwell hardness of various materials. The applying speed of test pressure can be adjusted by a buffering device, and the change of pressure is obtained by rotating a pressure selecting hand-wheel. Operation of the tester is quite easy, while the performance is stable and thus the tester can be used in a wide range.
- ② Working principle of the Rockwell hardness tester. The test procedure employs a conical diamond indenter or ball indenter of a certain diameter to press into the specimen, an initial test pressure P_0 and a main test pressure P_1 will be applied on the indenter in sequence, and the total pressure ($P_0 + P_1$) will be kept for a certain period, then the main pressure is to be removed, only the initial pressure will be left. A difference e between the indent depth h_1 by this time and the indent depth h_0 under the action of initial pressure, is recorded as a permanent increment of indent depth. Every 0.002 mm of this increment represents a unit of Rockwell hardness. This is a quick test and only trivial indent will be caused, so it is widely used to determine the hardness of specimen.

- ③ Calculation formula of Rockwell hardness test:

$$HRA(C) = 100 - e/0.002$$

$$HRB = 130 - e/0.002$$

$$e = h_1 - h_0$$

Installation

- ① Working conditions of the tester:

- ◆ Under ambient temperature, i.e. between 10-30 °C;
- ◆ The relative humidity in test room shall not be over 65%;
- ◆ In an environment free from vibration;
- ◆ No corrosive medium in surrounding.

2 Tester unpacking:

- ◆ Open the packing box cover and take out all cushion materials. Remove the accessory box.
- ◆ Lift the bottom plate, unscrew the two (2) M 10 bolts under the bottom plate with a spanner, to separate the hardness tester from bottom plate, all steps shall be done in a safe manner.
- ◆ After unpacking, the tester shall be placed on a stable bench with levelness deviation less than 1 mm/m. A hole shall be drilled at an appropriate location on the bench (see figure 1) to enable the lifting screw to operate properly.

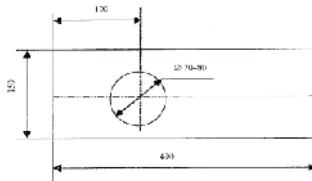


Figure 1

3 After the hardness tester is properly placed (see figure 2), remove the top cover (1). Untie the fastening white gauze tape on the extension rod (25, figure 5), then promptly replace the top cover to prevent dust from coming into the tester. Open the rear cover (2) and remove the white gauze tape on moveable parts. Wipe off the anti-rust oil on the lifting screw and apply some thin lubricating oil instead.

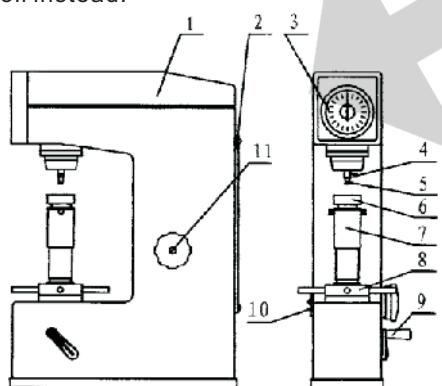


Figure 2

1. Top Cover
2. Rear Cover
3. Centigrade Panel
4. Indenter Locking Screw
5. Indenter
6. Test Stock
7. Lifting Screw Cover
8. Turn Wheel
9. Pressure Applying Handle
10. Buffer Adjustment Cover
11. Pressure Selecting Handwheel

4 Installation of weights (figure 3):

During weights installation the tester shall be at a test pressure-free state.

Take the weights out of the accessory box and rub them clean. Rotate the pressure selecting hand-wheel (11) to position 588, take out the hanger (14) from rear cover, and lead the hanger into the hole on weight A (18), then tighten the two M10 nuts (19) at the end of hanger, hook the hanger onto the hoist eye (13) at the rear of beam (12), and put weight B (17) and weight C (16) on two resting forks (15) respectively. Then turn the pressure selecting hand-wheel a whole cycle and ensure that the weights' pins shall fall into the groove on the resting forks.

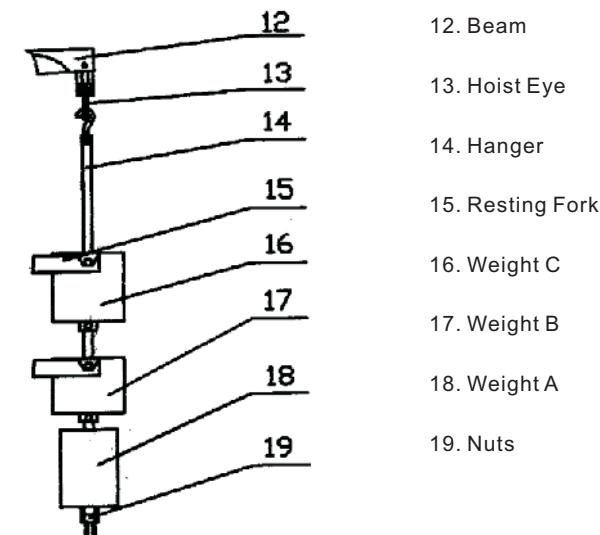


Figure 3

12. Beam
13. Hoist Eye
14. Hanger
15. Resting Fork
16. Weight C
17. Weight B
18. Weight A
19. Nuts

5 Relationship between selected test pressure and applied weights is shown as follow:

Scale	Test Pressure Graduation, N	Applied Weights
HRA	588	Hanger + Weight A
HRB	980	Hanger + Weight A + Weight B
HRC	1470	Hanger + Weight A + Weight B + Weight C

6 How to fill oil in the buffering device (figure 4):

The cylinder is filled with oil at the factory. In case of oil leakage during transportation, user can refill by himself as described below: loosen and take off two (2) screws on buffer adjustment cover (10), remove the cover and push the pressure applying handle (9) backward. Loosen nut (23), turn valve needle (24) counter-clockwise and fill #20 machine oil slowly through the hole on cylinder cover (21). The added oil shall be enough to let no empty suction sound be heard when pulling the pressure applying handle. Note: the oil level shall not exceed the joint surface between cylinder cover and cylinder body, otherwise oil will leak out.

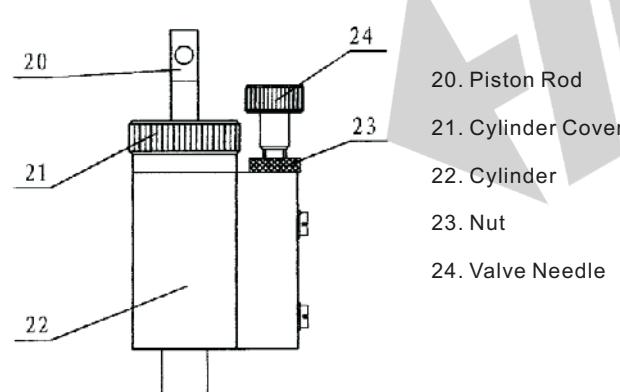


Figure 4

7 Main pressure applying speed adjustment:

Install the conical diamond indenter (5), place a HRC test block of lower hardness on the test stock (6), then rotate turn-wheel (8) clockwise to cause the test stock move upward. A pointer on centigrade panel (3) will start to rotate as soon as the test block touches the indenter. When the pointer has rotated for 3 complete circles, stop turning of the wheel (8) and push the pressure applying handle backward, and watch the turning speed of the pointer. The time period from start to stop of turning of the pointer shall be between 4 – 6 seconds. If the turning speed is too fast, it can be adjusted by reducing the flow rate in buffering device, i.e. to rotate the valve needle clockwise and make the trial again till the time period falling in specified range. If the speed is too slow, the adjustment procedure is the same as above only the valve needle shall be turned counterclockwise.

Operation

1 Preparation prior to the use:

- ◆ Surface of the specimen to be tested must be smooth and clean, free from dirt, scaling, indentation or significant marks resulted from machining. Scale, Indenter, Testing Pressure and Applicable Range for Rockwell Hardness Test .
- ◆ Minimum thickness of the specimen shall be larger than 10 times the depth of indenture. No obvious deformation shall be seen on back of the specimen after hardness test.
- ◆ The specimen to be tested shall be placed in stable state on top of the test stock. It shall be fixed during the test process. Ensure that the test pressure is perpendicularly exerted on the specimen.
- ◆ In case of a cylindrical shape specimen to be tested, the V type test stock shall be used and offset needs to be made to the values. Offset for cylindrical shape specimen shall be a positive value.

Scale	Indenter	Initial Pressure (N)	Combined Pressure (N)	Applications
A	Diamond indenter conical angle: 120° spherical radius at vertex: 0.2 mm		588.4	hard alloy, carbide for surface quenched steel, hard steel sheet
D			980.7	thin steel sheet, surface quenched steel
C			1471.0	quenched steel, tempered steel, hard cast iron
F	Ball indenter diameter: 1.5875mm (1/16in)	98.07	588.4	cast iron, aluminum, magnesium alloy, bearing alloy, annealed copper alloy, mild steel sheet
B			980.7	mild steel, aluminum alloy, copper alloy, malleable cast iron, annealed steel
G			1471.0	phosphorus iron, beryllium bronze, malleable cast iron
H	Ball indenter diameter: 3.175mm(1/8in)		588.4	aluminum, zinc, lead etc.
E			980.7	bearing alloy, tin, hard plastics, and other soft materials
K			1471.0	

The most commonly used scales for Rockwell hardness test are A, B and C.

② Hardness tester operation procedure:

- ◆ Choose a scale according to table 3 based on the rough hardness of the material to be tested. Rotate the pressure selecting hand-wheel clockwise to set the total pressure.
- ◆ When use the diamond indenter, press the head of diamond with middle finger and gently push it into the hole on indenter rod till it rests neatly on the supporting surface, then slightly tighten the indenter locking screw (4), and place the specimen on test stock (7).
- ◆ Rotate the turn wheel clockwise to let the lifting screw move upward, ensuring that the specimen to be tested slowly contact with the indenter with no impact, till the short pointer on the centigrade panel turn from the first step black point to the red one, and by this time the long pointer shall have passed three circles and point to position "C" (or position "B"

in case of HRB determination), which indicates that the initial test pressure of 98.07N is achieved. The deviation of long pointer shall not exceed 5 grades, otherwise the pointer shall not be allowed to turn back, instead that the test spot shall be changed to restart the operation.

- ◆ Rotate the graduation dial to set the pointer on position "C".
- ◆ Push the pressure applying handle slowly backward and ensure that the main pressure shall be wholly exerted in 4 – 6 seconds. The total pressure holding time period is 5 seconds, after then pull the pressure applying handle steadily forward in 2 – 3 seconds to remove the main pressure and only the initial pressure is left.
- ◆ The value pointed by the long pointer on centigrade panel at this time shall be taken as the determined hardness value of the specimen (in case of HRB determination, value shall be read from the inner circle).
- ◆ Rotate the lifting wheel counterclockwise to lower the test stock. Repeat above procedure at various spots.
- ◆ No less than 5 spots shall be tested for each specimen (first spot will not be accounted). Number of test spots may be reasonably reduced in case of lot inspection.

③ Adjustment of the hardness value display (figure 5).The accuracy of the tester is calibrated at factory. If any error is caused by improper handling during transportation, operator can make adequate adjustment but in prior to do that he shall thoroughly understand the structure and working principle of the tester apparatus. The procedure is as following: Remove the top cover. If displayed value is lower than the actual hardness of standard block, loosen M4 nut (26) and slightly turn in screw (28) clockwise, then tighten the nut and make the test again until the displayed value falls in the specified tolerance. If displayed value is higher, turn the screw counterclockwise.

Repeatability & Tolerance of Rockwell Hardness Display Value:

Scale	Hardness of Standard Blocks	Display Tolerance	Allowable Display Repeatability ^{a)}
A	20HRA - ≤75HRA	±2HRA	≤0.02(100-H) or 0.8 Rockwell Unit ^{b)}
	>75HRA - ≤88HRA	±1.5HRA	
B	20HRB - ≤45HRB	±4HRB	≤0.04(130-H) or 1.2 Rockwell Unit ^{b)}
	>45HRB - ≤80HRB	±3HRB	
	20 HRC - ≤70HRC	±1.5HRC	
C	20 HRC - ≤70HRC	±1.5HRC	≤0.02(100-H) or 0.8 Rockwell Unit ^{b)}

^{a)} Where H is the mean hardness value.
^{b)} Take the larger one of these two values as basis.

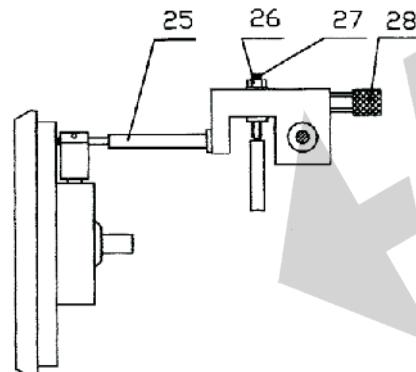


Figure 5

25 Extension Rod 26 Nut 27 M4 Screw 28 Screw

Maintenance

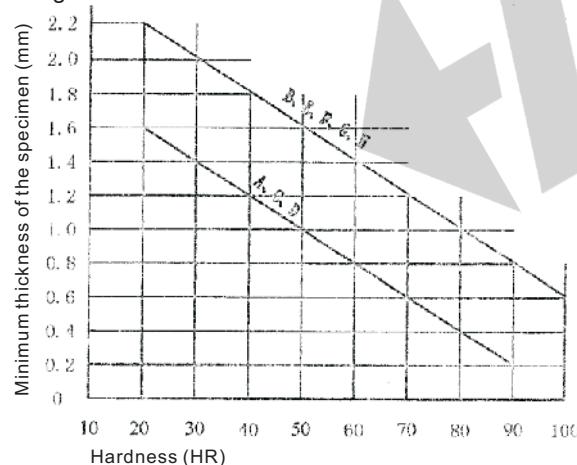
- 1 The operator shall operate the tester by following the instructions contained in this manual. Frequent calibration against standard blocks is necessary before and after actual tests. For tester not frequently used, several pre-tests shall be done on the standard blocks after the tester is turned on.
- 2 During a hardness test, it is strictly prohibited to turn the pressure selecting hand-wheel when applying, keeping or removing the testing pressure.
- 3 Use of the standard blocks can only be done on their working surface. A minimum distance of 3 mm between two successive test spots or between the center of indent and edge of the specimen is necessary. Life period of a standard block is limited to 2 years.
- 4 When handling the hardness tester, the extension rod shall be fixed, and the weights and hanger shall be removed.
- 5 The hardness tester shall be kept in clean state. After completion of testing procedure, the tester shall be covered with a dust cover. Hardness block and indenter shall be coated with antirust oil after use to prevent rust and corrosion.
- 6 Periodical verification shall be done, at least once a year, on the tester so as to ensure its accuracy.
- 7 Common trouble shooting. It is recommended that the user contact the manufacturer if problems occur with the tester. However, the following table may help the user to detect and solve some common problems.

Problem	Possible cause	Suggested remedy
The long pointer deviates from its zero point.	Adjustment of displayed value may cause deviation of the long pointer.	Refer to figure 5. Slightly loosen nut and turn M4 screw in small increment to align the pointer onto its zero point, then fix the screw and fasten the nut.

Extraordinary error occurs on display	1.Damaged indenter. 2.Wrong order of weights placement. 3.Friction between weights and inner wall of the tester body caused by unleveled installation of the tester. 4.The dust-proof cover is higher than the supporting surface of the lifting screw. 5.Wrong selection of total test pressure or indenter.	1. Replace diamond indenter or ball indenter. 2. Place weights according to figure 3. 3. Calibrate the tester with a leveling instrument 4. Lower the dust-proof cover to below the upper surface of the lifting screw and fasten the screw. 5. Select appropriate test pressure according to table 2.
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Appendix

① Minimum thickness of the sample shall be larger than 10 times the depth of indenture. No obvious deformation shall be seen on back of the sample after hardness test. The relationship between minimum thickness of the sample and its hardness are shown in the following table .



② Offsets for Rockwell hardness test when diameter of the specimen is less than 38 (25) mm.

Hardness Value (HRC) (HRA)	Diameter of Cylindrical Specimen (mm)								
	6	10	13	16	19	22	25	32	38
Offsets (HR) to Rockwell Scale C & A									
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	1.0	0.5	0.5
40	2.5	2.0	1.5	1.0	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	0	0	0
80	0.5	0.5	0.5	0.5	0	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 (HRB)	Diameter of Cylindrical Specimen (mm)						
	6	10	13	16	19	22	25
Offsets (HR) to Rockwell Scale B							
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

Specification

Hardness scale	HRA, HRB, HRC, HRD, HRF, HRG
Preliminary test force	98N
Test force	588N, 980N, 1471N
Display	analogue
Stage elevation	manual
Load control	manual
Min. reading	0.5HR
Max. workpiece height	170mm
Max. workpiece depth	165mm (from the center of indenter)
Dimension	520×160×700mm
Weight	60kg

Standard Delivery

Main unit	1pc
Ø60mm flat anvil	1pc
Ø150mm flat anvil	1pc
V-type anvil	1pc
Diamond indenter	1pc
Ø1.5875mm carbide ball indenter	1pc
Hardness test block HRB85-95	1pc
Hardness test block HRC60-70	1pc
Hardness test block HRC20-30	1pc