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OPERATION MANUAL

ISH-NMR150
Motorized Rockwell Hardness Tester

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Special Attentions

1. 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.
2. Fastening tapes and cushion materials shall be carefully removed before installation and calibration of the apparatus.
3. The power source plugs of instruments must use the single-phase three cores plug, and the ground terminal must conform to the requirement of stipulation protective.
4. The various electric appliances part of the instruments and the installation's position of switch plug should strictly prohibit voluntarily disassembling and installation, if you arbitrarily do that, an accident can be opened.
5. Never rotate the pressure selecting handwheel or turn-wheel when applying, keeping or removing the testing pressure.
6. 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.

Content

1. A Brief Introduction to ISH-NMR150 Motorized Rockwell Hardness Tester

1.1 The degree of hardness is one of material machine capability important targets, and the hardness test is one of the important methods about judging the metal material or the components quality. Because the metal degree of hardness has the mutual corresponding relations with other machine capability. Therefore, determining the degree of hardness may approximately calculate the majority metal material's other machine capability, such as intensity, weary, slow change, attrition and so on.

1.2 An automatic testing pressure loading / unloading mechanism, as well as a potentiometer for total testing pressure holding time adjustment, are equipped on ISH-NMR150 Motorized Rockwell Hardness Tester, and the testing pressure change can be obtained by turning of the load-selection handwheel, making its operation easy and simple. The tester enjoys high sensitivity and stability, thus is designed for use in workshops and laboratories.

2. Technical Specifications of the Hardness Tester

2.1 Initial Pressure: 98.07N , tolerance: ±2.0%

2.2 Total Pressure: 588.4N, 980.7N, 1471N, tolerance: ±1.0%

2.3 Specification of Indenter:
2.3.1 Conical diamond Rockwell indenter
2.3.2 Φ1.5875 mm ball indenter

2.4 Max Height of Specimen: 170 mm

2.5 Distance between Center of Indenter and the Column: 165 mm

2.6 Overall Size of the Tester (L×W×H): 520×240×700 mm

2.7 Total Weight of the Tester: 80 kg (approx.)

2.8 Repeatability & Tolerance of Rockwell Hardness Display Value (Table 1)

(Table1)

Scale	Hardness of Standard Blocks	Display Tolerance	Allowable Display Repeatability
A	20HRA - ≤75HRA	±2HRA	≤0.02(100-$\bar{H}$) or 0.8 Rockwell Unit
	>75HRA - ≤88HRA	±1.5HRA	
B	20HRB - ≤45HRB	±4HRB	≤0.04(130-$\bar{H}$) or 1.2 Rockwell Unit
	>45HRB - ≤80HRB	±3HRB	
	>80HRB - ≤100HRB	±2HRB	
C	20 HRC - ≤70HRC	±1.5HRC	≤0.02(100-$\bar{H}$) or 0.8 Rockwell Unit
a) Where $\bar{H}$ is the mean hardness value. b) Take the larger one of these two values as basis.			

3. Scale, Indenter, Testing Pressure and Applicable Range for Rockwell Hardness Test (Table 2)

(Table 2)

Scale	Indenter	Initial Pressure (N)	Combined Pressure (N)	Applications
A	Diamond indenter conical angle: 120° spherical radius at vertex: 0.2 mm	98.07	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)		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.

4. Installation of the Tester

4.1 Working conditions of the tester:

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

4.2 Tester unpacking

4.2.1 Remove nails, open the packing box cover and take out all cushion materials.
4.2.2 Remove the accessory box.
4.2.3 Loosen the four (4) nuts on bottom of the packing box, then lift the box upward and remove it.
4.2.4 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.
4.2.5 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.

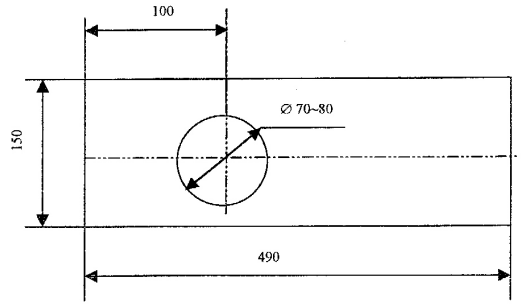


Figure 1

4.3 After the hardness tester is properly placed (see figure 2), remove the top cover (1) and the rear cover (2). Untie the fastening white gauze tape on the extension rod (8, 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.

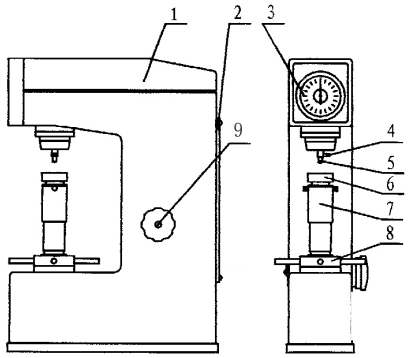


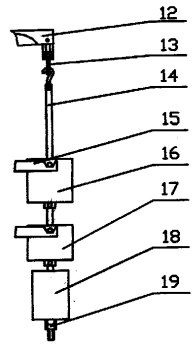
Figure 2

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 Selecting Handwheel

4.4 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. Turn the pressure selecting handwheel (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 handwheel a whole cycle and ensure that the weights' pins shall fall into the groove on the resting forks.



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

Figure 3

Relationship between selected test pressure and applied weights (table 3)

Table 3

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

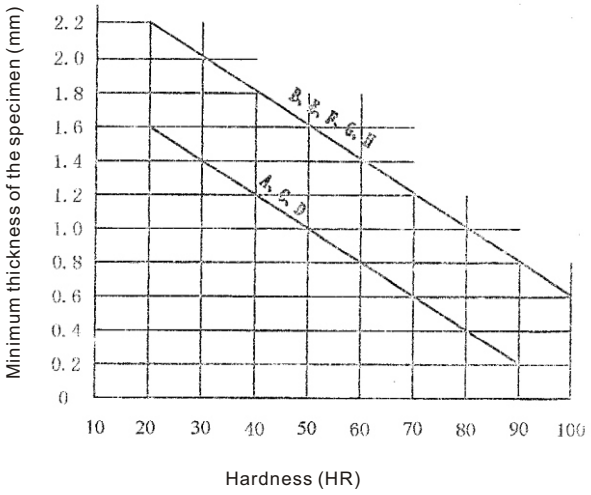
5. Proper Use of the Tester

5.1 Preparation prior to the use

5.1.1 Surface of the specimen to be tested must be smooth and clean, free from dirt, scaling, indentation or significant marks resulted from machining.

5.1.2 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 relationship between minimum thickness of the specimen and its hardness are shown in the following table (table 4).

Table 4



5.1.3 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.

5.1.4 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.

5.1.5 Offsets for Rockwell hardness test when diameter of the specimen is less than 38 (25) mm (table 5)

5.2 Hardness tester operation procedure

5.2.1 Plug the power cord (11) and turn on the boat-shape switch (13). The illuminating light (10) is on.

5.2.2 Rotate the graduation dial to set the pointer on position “C”.

5.2.3 Choose a scale according to table 2 based on the rough hardness of the material to be tested. Turn the pressure selecting handwheel clockwise to set the total pressure.

5.2.4 When use the diamond indenter (5), 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 sample on test stock (6).

5.2.5 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 black point to the red one, and by this time the long pointer shall have passed three turns and point to position “C” (or position “B” in case of HRB determination), this 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 the test spot shall be changed to restart the operation.

5.2.6 Rotate the panel to the set the pointer on position “C”.

5.2.7 Press the start button, motor starts to exert main test pressure automatically. Indication light turn off automatically.

5.2.8 When the total pressure is held for the predetermined period, motor will restarts to remove the main pressure and the indicator light will turn on.

5.2.9 The value pointed by the long pointer on centigrade panel at this time shall be taken as the determined hardness value of the sample (in case of HRB determination, value shall be

read from the inner circle).

5.2.10 Rotate the lifting wheel counterclockwise to lower the testing table. Repeat above procedure at various spots.

5.2.11 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.

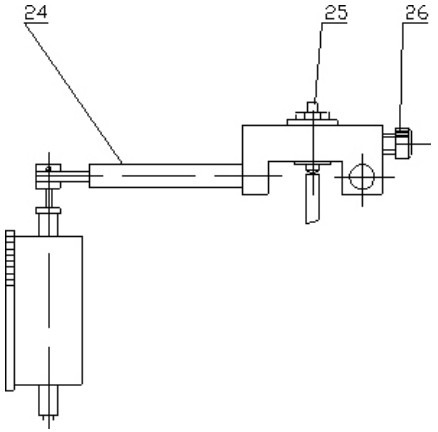
Table 5

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	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 (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

5.3 Adjustment of the hardness value display (Figure 4)

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 (1). If displayed value is lower than the actual hardness of standard block, loosen M4 nut (25) and slightly turn in screw (26) clockwise, then tighten the nut and make the test again until the displayed value falls in the specified tolerance (table 1). If displayed value is higher, turn the screw counterclockwise.



24. Extension Rod 25. Nut 26. Screw

Figure 4

6. Maintenance & Special Attentions

6.1 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.

6.2 During hardness test, it is strictly prohibited to turn the pressure selecting handwheel when applying, keeping or removing the testing pressure.

6.3 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.

6.4 When handling the hardness tester, the extension rod shall be fixed, and the weights and hanger shall be removed.

6.5 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.

6.6 Periodical verification shall be done, at least once a year, on the tester so as to ensure its accuracy.

6.7 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 (table 6)

Table 6

Problem	Possible cause	Suggested remedy
Indicator lamp do not light up when tester is turned on	1.No power 2.Fuse blows out 3.Damaged lamp	1. Check if the power cord is properly connected. 2. Replace the fuse with the new one in accessory box. 3. Replace the lamp with the new one in accessory box.
The long pointer deviates from its zero point.	Adjustment of displayed value may cause deviation of the long pointer.	Refer to figure 4. 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 according to 4.2.4. 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.

7. Accessories

Item No	Description & Specification	Quantity
1	Diamond Rockwell Hardness Indenter	1
2	Φ1.5875mm Ball Indenter	1
3	Large Size Test Stock	1
4	Small Size Test Stock	1
5	V Type Test Stock	1
6	Standard Rockwell Hardness Blocks	
	HRB	1
	HRC high & low	2 in total
7	Fuse (0.5A) (5×20)	1
8	Power Cord	1
9	Weights A, B, C	3 in total
10	Dust-proof Plastic Cover	1
11	Product Quality Certificate	1
12	Instruction Manual	1