



**HDT-RA151
AUTOMATIC ROCKWELL HARDNESS TESTER
(BASIC TYPE)
OPERATION MANUAL**



Safety precautions

Before you install and use this product, please read this manual carefully; and pay special attention to the contents of reminders and suggestions, follow the precautions; avoid damage to equipment, fire and personnel injury!

- ◆ Check the input range of power supply voltage before use whether the equipment is in accordance with the equipment grounding requirements.
- ◆ determine if the environment meets the installation requirements.
- ◆ operate equipment according to operating procedures.
- ◆ unplug the power when cleaning the equipment.
- ◆ Do not break down the equipment when failure occurs, should ask professional maintenance, so as to avoid electric shock.
- ◆ please keep this manual properly.

Overview

◆ Hardness

Hardness is the ability of a material to resist elastic deformation, plastic deformation, or destructive power. For the hardness test carried out by the indentation method, hardness is the ability of the substance to resist another harder object with a certain shape and size to press into its surface.

◆ Principle of Rockwell Hardness Test

The Rockwell hardness test is done with a specified pressure head, Under the action of two test forces (initial test force F_0 and total test force F), Press into the surface of the specimen, After the total test force has been maintained, Discharging F_1 , of main test forces Retain the test force, Measuring h_1 , of indentation depth The difference between the indentation depth h_1 and the indentation depth h_0 under the initial test force Δh indicating the Rockwell hardness, The axial displacement of the head is 0.002 mm as a Rockwell hardness unit, Generally read directly from the indicator dial, The principle of action is shown below.

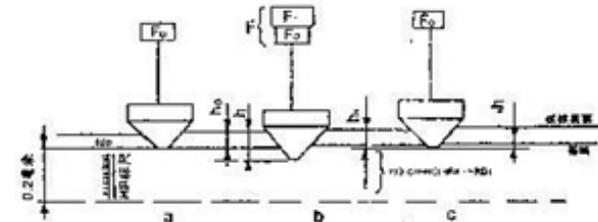
Rockwell hardness values as per

$$HR = K - \frac{h_1 - h_0}{C}$$

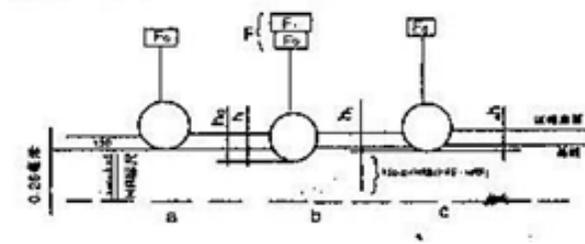
Formula: C: constant, equal to 0.002 mm;

K: constant ,100 when using diamond cone indenter ,130 when using steel ball indenter.

Rockwell hardness test schematic



- (1) test principle of diamond cone indenter
 a-after adding the initial test force
 b-after adding the total test force
 c-after removing the total test force



(2) test principle of steel ball indenter
 a-after adding the initial test force
 b-after adding the total test force
 c-after removing the total test force

◆ Characteristics of Rockwell Hardness Test

Rockwell hardness test adopts the method of measuring indentation depth, hardness value is read out directly by indication, so the operation is simple and convenient, easy to master, high working efficiency, suitable for batch parts inspection; Rockwell hardness test method can be used to measure hard and soft samples. Rockwell hardness tester is the most commonly used test instrument for hardness testing, teaching and scientific research in production enterprises, universities and colleges.

Application of hardness tester

Rockwell hardness test according to the material hardness range, test thickness is different, can choose different pressure head and test force, and expressed by different scale, the most commonly used A、B、C scale, the following table gives the commonly used scale test force, pressure head, constant K value and application range and application examples.

Scope of use of Rockwell hardness tester

Rockwell Hardness scale	Hardness symbol	Head type	F ₀ of Initial Tests (kg)	F ₁ of Main Test Strength (kg)	F of total test forces (kg)	Constant	Scope of application	Examples of applications
A	HRA	Diamond cone press	10	50	60	100	20-88 HRA	Hard metal and hard alloy
B	HRB	Diameter 1.5875 mm Ball head	10	90	100	130	20-100 HRB	Non-ferrous and soft metals
C	HRC	Diamond cone press	10	140	150	100	20-70 HRC	Heat treatment of structural steel Steel
D	HRD	Diamond cone press	10	90	100	100	HRD 40-77	Surface hardened steel, thin steel
F	HRF	Diameter 1.5875 mm Ball head	10	50	60	130	60-100 HRF	Non-ferrous metals
G	HRG	Diameter 1.5875 mm Ball head	10	140	150	130	HRG 30-94	pearlite iron, copper nickel, Zinc alloy

A scale: suitable for measuring metals with hardness over 70 HRC, such as tungsten carbide, cemented carbide, hard thin plate materials and surface hardened materials.

B scale: used to determine soft or medium hardness materials such as non-ferrous metals and their alloys, annealed steel or unhardened steel products.

C scale: used to determine the hardness of heat treated steel products such as carbon steel, tool steel and alloy steel.

Main technical parameters

- ◆ Initial test force :98.07 N (10kgf)
- ◆ Total test forces :588.4 N (60 kgf), 980.7 N (100 kgf), 1471 N (150 kgf)
- ◆ Indicator scale: C:0~100; B:30~130
- ◆ Maximum height of specimen :100 mm,170 mm(without screw sheath)
- ◆ Distance from indentation center to machine wall :128 mm
- ◆ Size of hardness tester :500×225×640(mm)
- ◆ Hardness gauge net weight :65 kg

Mechanism performance brief

The hardness tester is composed of the fuselage, the test force application mechanism, the measuring indicator mechanism and the specimen support mechanism. See Figure (ii).

The fuselage is a closed shell, except the worktable, lead screw and handle are exposed, the other mechanisms are installed in the fuselage shell to keep clean.

Test force application mechanism consists of spindle, lead screw, blade, weight buffer, weight conversion mechanism, control handle and so on.

The initial test force is mainly produced by the weight of parts such as spindle (1) circular knife (2) long rhombic knife (3) large lever (4) small lever (21) top rod (5) and the measuring pressure of indicator (24) etc. When the specimen is in contact with the head and continues to rise, When large or small levers are placed horizontally, Large pointer vertical upward) due to the weight of the lever, etc., and the measuring pressure of the indicator, Head pressure can be subjected to (10 kg)98.07 N initial test force.

The fuselage is equipped with a weight load changer (12). When the handle (13) is rotated to different positions, three different total test forces N 1471 N or 980.7 N or 588.4 can be obtained.

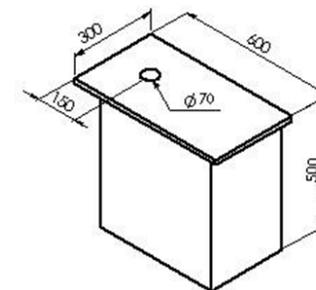
The measuring index mechanism consists of the top rod (5) small lever (21) adjustment plate (22) connecting rod (23) and indicator (24) and other parts. When the pressure head is lifted up, the top rod (5) lifts the small lever (21) and drives the pointer of the indicator (24) through the connecting rod (23) to rotate.

The specimen support mechanism consists of a worktable (25) lead screw (26) handwheel (27) lead screw seat (30) protective sleeve (29). It is worth mentioning that compared with other manufacturers of the same type of hardness meter, the hardness meter has added a protective sleeve (29), avoiding dust and sundries in the process of use, reducing the wear on the support surface, thus making the operation more lubricated and smooth. The indication is more accurate and stable.

Installation of hardness tester

◆ Preparation

- ① The working environment of hardness meter should be dry and clean without corrosive gas.
- ② The working environment of hardness meter should be free of mechanical vibration from outside.
- ③ The working environment of hardness meter should be between $23\pm 5^{\circ}\text{C}$.
- ④ The test bench (self-provided) shall be based on cement or metal, with a certain stiffness and strength, capable of carrying the hardness meter and its accessories, and the table shall be as shown in the diagram (size for reference only) with holes greater than $\Phi 50$ mm for wire bars. The flatness of the whole table should be within $0.2/1000$. Proper space should be left around the hardness meter for necessary installation, maintenance, commissioning and so on.



◆ Unboxing (see figure I)

- 1 By opening the top cover of the packing box and removing the four fixed screws at the bottom of the fuselage, the hardness tester can be installed on the test bench in a dry, clean and non-corrosive gas and non-vibration room.
- 2 Check the integrity of the attachment according to the packing list.
- 3 Open the cover (6) and the back cover (19).
- 4 Loosen the nut (8) and remove the hook head screw (9).
- 5 Remove large lever fixed pressure block (7) and fixed support block (11).
- 6 Loosen nut (13) remove hook head screw (12) remove weight fixing plate (14).
- 7 Hold the ring (10) up with your hand and slowly lift the weight group (17) and remove the weight fixed support block (18) at the same time. Then, gently put down the weight group (17) so that the weight cylinder pin (15) falls into the groove of the support plate (16) and holds the weight.
- 8 Untie the small lever fastening rope (4).
- 9 Turn the handwheel (1) to lower the lead screw (2) and remove the head pad (3). Remove the lead screw cover (20), use kerosene to wash the antirust oil applied to the lead screw, handwheel and so on, then inject a small amount of lubricating oil in the contact between the lead screw and the handwheel, and re-set the lead screw protection suit. Check that the position of the adjustment block (21) on the large lever (5) is between two red marks, otherwise it should be reloaded into the correct position. Install the large flat table on the upper end of the lead screw (2), and then put the level on the working table. Metal gasket pad can be used on the bottom of the fuselage to adjust the flatness of the hardness meter within 0.2/1000.

Operation methods and precautions

◆ Key operation instructions:



-	main test force hold time to reduce keys
+	main test force hold time increase key
START	start button

◆ Preparation before testing (see figure II)

- 1 Selection of test forces:
Select the test force according to the need. Turn the handle (13) to align the selected test force value to the red dot, but it must be noted that when changing the test force, it must be placed in a unloading state.
- 2 mounting head:
Select the appropriate pressure head according to the scope of use. When installing the head, attention should be paid to eliminating the gap between the head and the spindle (1) end face. The elimination method is to install the pressure head and gently fix the screw (28), then place the standard block or specimen on the worktable, rotate the handwheel (27) and add the initial test force, pull the handle (15) to add the main test force to the pressure head, and then screw (28) Tighten to eliminate the gap between the head and the end face of the spindle.

3 Preparation and selection of specimens:

The specimen should have a certain size and thickness, which should ensure that the distance between the adjacent indentation center and the indentation center to the edge of the specimen is more than 3 mm, and the minimum thickness of the specimen should not be less than eight times the indentation depth. After the test, there must be no obvious deformation marks on the support surface of the sample. The minimum thickness depends on the material and the load used. Please refer to the minimum thickness table below.

Sample minimum thickness table

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

The specimen is generally plane. If the curved surface specimen is tested and its curvature radius is small, the test results should be corrected. For convex samples, correction values should be added, for concave samples, correction values should be subtracted, and the correction values of cylindrical samples can be referred to the table below.

Correction value of cylinder specimen B、F、G scale

Hardness value (HR)	Correction value of Rockwell B F G scale (HR)						
	Curvature radius/ mm						
	3	5	6.5	8	9.5	11	12.5
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

Correction of cylindrical specimen C、A、D scale

Hardness value (HR)	Correction value of Rockwell C A D scale (HR)								
	Curvature radius/ mm								
	3	5	6.5	8	9.5	11	12.5	16	19
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	1.0
35		3.0	2.0	1.5	1.5	1.0	1.0	0.5	0.5
40		2.5	2.0	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	0.5	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

The surface of the sample must be polished or polished, and the surface roughness should not be lower than that of the material when the Ra1.6, is processed, that is, there should be no work hardening or tempering, and the surface roughness of the support surface should not be lower than that of the Ra3.2, sample face. The sample should be placed smoothly on the workbench and should not move during the test.

The installation of the specimen must ensure that the applied test force is perpendicular to the test surface. For bending and other irregular samples, the corresponding type of special worktable must be adopted and the correct test position must be selected. For example, for cylindrical specimens, the "V" type table" must be used.

◆ Test procedure (see figure II):

- ① Wipe the top surface of the lead screw (26) and the lower end surface of the selected worktable, and place the worktable on the end face of the lead screw (26).
- ② Clean the support surface of the specimen, place it on the worktable, rotate the handwheel (27) to make the worktable rise slowly, and lift the head up until the small pointer of the indicator points to the red dot, and the large pointer rotates three circles vertically up (allowing a difference ±5 scales, If more than 5 scales, this point is invalid, re-test).
Note: when the workbench rises, there is absolutely no retreat.
- ③ Rotate indicator (24) housing so that long lines between C、B and large fingers are positive (clockwise or counterclockwise).
- ④ Press the start button on the lower panel to apply the main test force, and the large pointer of the indicator rotates counterclockwise.
- ⑤ When the main test force is added into the test force to maintain the state, digital tube countdown, after the end of the time to remove the main test force.
Note: the application and removal of the main test force should be carried out in a slow no impact state.
- ⑥ Immediately from the indicator of the corresponding ruler reading, using diamond head test, according to the dial outer ring black body reading, using ball head test, according to the dial inner ring red body number read.
- ⑦ Immediately from the indicator of the corresponding ruler reading, using diamond head test, according to the dial outer ring black body reading, using ball head test, according to the dial inner ring red body number read.

Note: a.the specimen must be close to the work table movement;
 b.must ensure that the distance between the adjacent indentation center and the center to the edge is greater than 3 mm;
 c.usually the first test is only used to offset the gap between the support surfaces, the test results should be taken from the second Point statistical test results.

- 8 The lead screw protective sleeve (31) is set to protect the lead screw (26) from dust. When the hardness meter is not in use or when the specimen height is less than 100 mm, cover it outside the lead screw. When the height of the specimen is more than 100 mm, it must be removed so as not to lift the worktable and make the test invalid.

Hardness tester maintenance and calibration

- ◆ The hardness tester shall be used in a clean, vibration-free environment with a temperature of $23\pm 5^{\circ}\text{C}$.
- ◆ When the hardness meter is not used for a long time, cover the machine with a dust shield.
- ◆ Regularly inject a small amount of oil into the contact surface between the lead screw (26) and the handwheel (27).
- ◆ If it is found that the indication error of hardness meter is large ,(1) the worktable can be taken down to check whether the contact surface with the lead screw is clean ;(2) check whether the lead screw protective sleeve is lifted up the working table ;(3) check whether the pressure head is damaged.
- ◆ Check the accuracy of hardness meter regularly with the standard hardness block of this machine.
 - (a) Wipe the table and standard block clean, test on the hardness block face, never allow to test on the support surface.

(b) If the indication error is large, in addition to checking according to item 4 of this section, we should also check whether there are burrs on the support surface of the standard hardness block, and if there are burrs, use oil stone to polish them.

(c) When the standard block is tested in different positions, the hardness block should be dragged close to the working table.

(d) Hardness gauge indication adjustment: if through the above work, hardness meter indication error is still large, can be adjusted by the plate(22) The front and back position to meet the accuracy requirements. Method: loosen the adjustment plate (22) before and after the two M3 screws, before and after moving the adjustment plate (22) position. Note that when moving towards the indicator, the indicator increases and vice versa. After adjustment, fasten the loosened two M3 screws. If it is found that the indicator pointer is not vertical after adjustment, the back cap on the M3 screw in the middle of the adjustment plate can be loosened, and the pointer can be rotated to meet the requirements.

(e) If the user has any other questions, contact the manufacturer in time to get the correct solution. It is strictly forbidden to disassemble by oneself to prevent unnecessary loss.

Figure I:

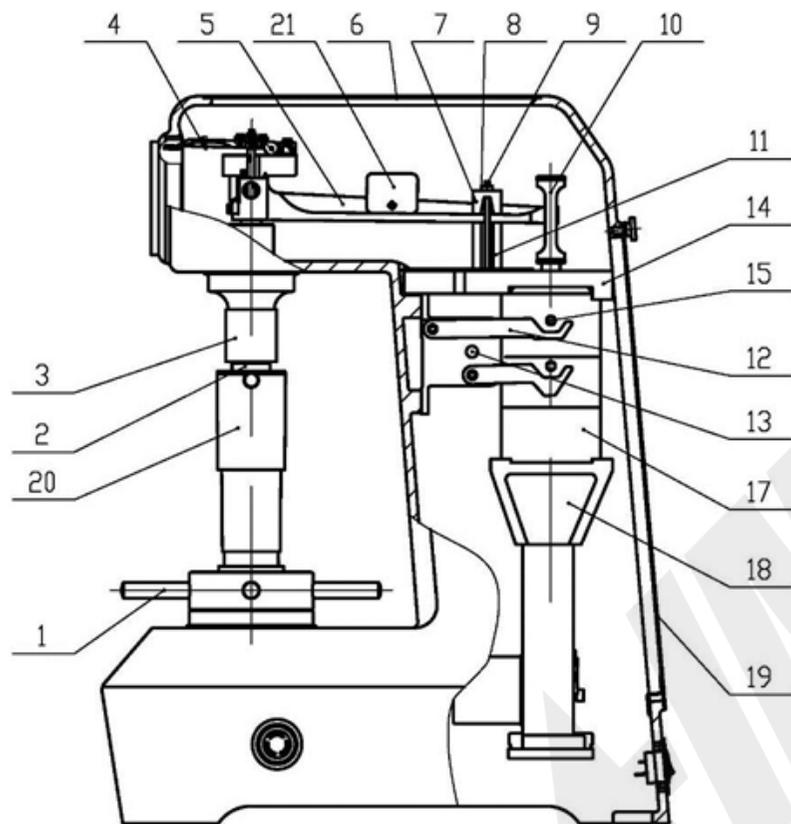


Figure II:

