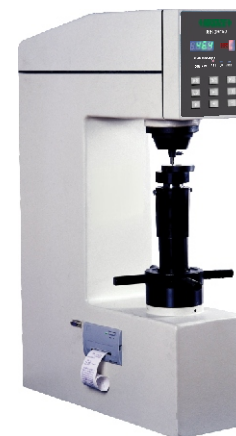




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OPERATION MANUAL

**Model ISH-DR150
Digital Rockwell Hardness Tester**



Important Notes

1. This instruction manual shall be read through prior to the use of the apparatus, to understand the detailed operation steps and special attentions, in order to prevent apparatus damage and/or personal injury resulted from improper operation.
2. All bands and shake-reducing tapes shall be carefully removed before apparatus installation and calibration.
3. It is strictly prohibited to tamper with the installation position of all electric elements. Switches, sockets etc. It may cause damage and/or injury.
4. It is not permitted to turn the pressure selecting hand-wheel or lifting screw during the testing pressure charging or relieving period (i.e. when the pressurizing motor is turning) or during the pressure keeping period.

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1. A Brief Introduction to ISH-DR150

1.1 ISH-DR150 Digital Rockwell Hardness Tester is a novel product integrating advanced mechanical and electronic technologies and featured with neoteric appearance, intuitive digital display, microprocessor control, and stable performance etc. It can be used in a wide range of Rockwell hardness determination. The main functions include the followings:

- 1.1.1 Selection of Rockwell hardness scales;
- 1.1.2 Selection of hardness testing pressure keeping period;
- 1.1.3 Reset function;
- 1.1.4 Printout of hardness test result;
- 1.1.5 RS-232C serial communication interface for functional extension.

1.2 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 P0 and a main test pressure P1 will be applied on the indenter in sequence, and the total pressure (P0 + P1) 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 h1 by this time and the indent depth h0 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 materials' hardness.

1.3 Calculation formula of Rockwell hardness test

$$\text{HRA (C)} = 100 - e/0.002$$

$$\text{HRB} = 130 - e/0.002$$

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:
 - 1.3.1 Conical diamond Rockwell indenter
 - 1.3.2 Φ1.5875 mm ball indenter
- 2.4 Time Delay Control: 1~30 seconds
- 2.5 Max Height of Sample: 170 mm
- 2.6 Distance between Center of Indenter and the Column: 165 mm
- 2.7 Overall Size of the Tester (L×W×H): 510×212×730 mm
- 2.8 Total Weight of the Tester: 85 kg (approx.)
- 2.9 Repeatability & Tolerance of Rockwell Hardness Display Value (Table 1)

Table 1

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

^{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, surface quenched steel, carburizing steel
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			588.4	aluminum, zinc, lead etc.
E	Ball indenter diameter: 3.175mm (1/8in)	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.

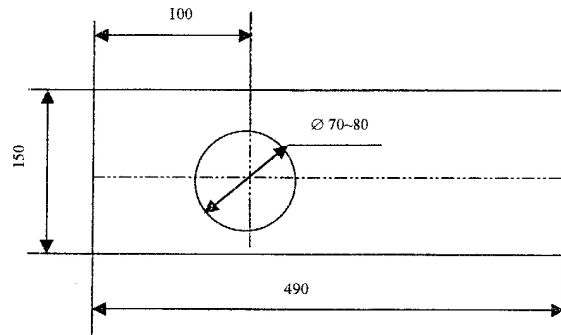
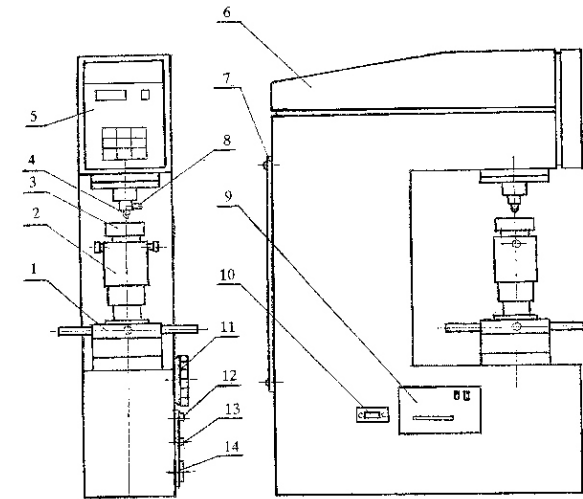


Figure 1

- 4.3 After the hardness tester is properly placed, remove the top cover (6, figure 2). Untie the fastening white gauze tape on the extension rod (27, figure 5) and withdraw wires at the displacement sensor (23) and extension rod, then remove the gasket on the indenter rod (24). Promptly replace the top cover to prevent dust from coming into the tester. Loosen screws and remove the lifting screw cover (2, figure 2). Wipe off the anti-rust oil on the lifting screw and apply some thin lubricating oil instead. Open the rear cover (7) and remove the white gauze tape on moveable parts.

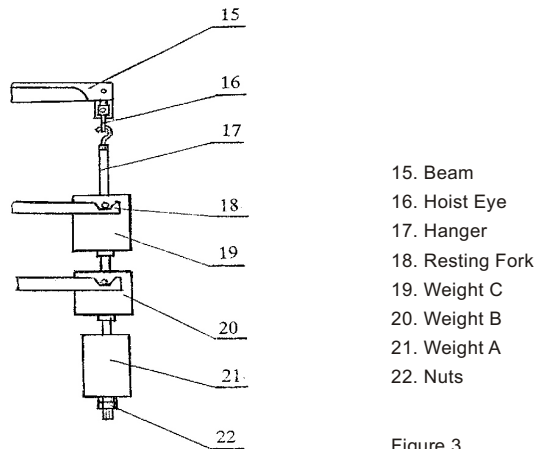


- | | |
|------------------------|----------------------------------|
| 1. Turn Wheel | 8. Indenter Locking Screw |
| 2. Lifting Screw Cover | 9. Panel Type Printer |
| 3. Test Stock | 10. RS-232C Adaptor |
| 4. Indenter | 11. Pressure Selecting Handwheel |
| 5. Panel | 12. Switch |
| 6. Top Cover | 13. Fuse Plug |
| 7. Rear Cover | 14. Power Source Plug |

Figure 2

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 (17) from rear cover, and lead the hanger into the hole on weight A (21), then tighten the two M10 nuts (22) at the end of hanger, and hook the hanger onto the hoist eye (16) at the rear of beam (15), and put weight B (20) and weight C (19) on two resting forks (18) 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.



- 15. Beam
- 16. Hoist Eye
- 17. Hanger
- 18. Resting Fork
- 19. Weight C
- 20. Weight B
- 21. Weight A
- 22. Nuts

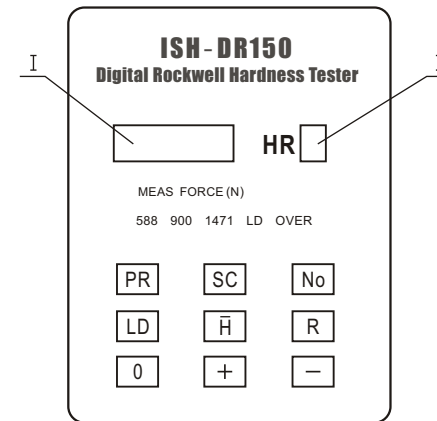
Figure 3

4.5 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	1471	Hanger + Weight A + Weight B + Weight C

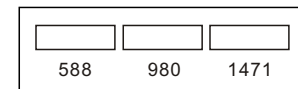
5. Touching Panel Button Functions Description (Figure 4)



- I. Hardness value is indicated in HR on digital display I. The display is also used to show the predetermined period and times of hardness test.
- II. Digital display II is for hardness scale indication, 9 types of scale can be displayed, namely HRC, HRF, HRB, HRG, HRH, HRE, HRK, HRA and HRD.

Figure 4

- increment button, 1 is added each time this button is depressed.
- decrement button, 1 is lessened each time this button is depressed.
- scale selection button, any one of 9 Rockwell scales can be selected and shown on digital display II.



Three test pressure choices corresponding to 9 scales. If scale A is selected, then indicator lamp 588 will be lit. Scale C is generally selected and will be automatically indicated when turning on of the tester.

Pressing of button, a numeral 3 will be shown on digital display number I which means the hardness test is predetermined to be carried out on 3 points. Pressing or button to increase or decrease the test times, If you want to clear the test times, please press again. The times should be less than 20, and the first test point data of each test will not be recorded by the printer.

LD Pressing of **LD** button, a numeral 5 will be shown on digital display number 1 which means the lasting period of total test pressure will be 5 seconds. Pressing **+** or **-** button to change the test period. The longest selectable period is 30 seconds. If you want to clear the test period, please press **LD** again.

LD Indication lamp for time delay. The beginning and end of total test pressure holding period are indicated by turn-on and turn-off of this lamp respectively.

O Clear data button.

R Reset button. The button is used to clear all setting data.

OVER This indicator will light up when the tester has completed pre-selected test times, and the record can be printed-out by this time.

H-- This button is used to show the mean of hardness test value on digital display number 1.

PR Print command button. When OVER indicator is on, printing data can be done by pressing this button.

6. Proper Use of the Tester

6.1 Preparation

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

6.1.2 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 (Table 4).

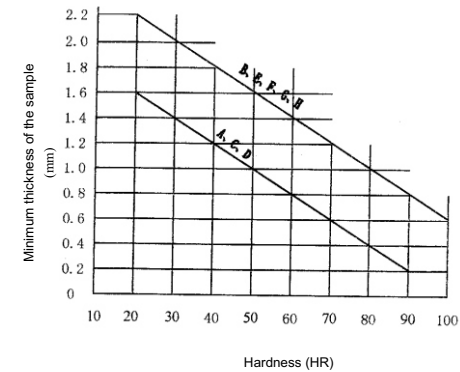


Table 4

6.1.3 The sample 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 sample.

6.1.4 In case of a cylindrical shape sample to be tested, the V type test stock shall be used and offset needs to be made to the values.

6.1.5 Offsets for Rockwell hardness test when diameter of the cylindrical sample is less than 38mm.(Table5)

Table 5

Hardness Value (HRC) (HRA)	Diameter of Cylindrical Samples (mm)								
	6	10	13	16	19	22	25	32	38
	Offsets (HR) to Rockwell Scale C & A								
25				2.5	2.0	1.5	1.5	1.0	1.0
35			3.0	2.5	2.0	1.5	1.0	1.0	1.0
40			2.5	2.0	1.5	1.5	1.0	1.0	0.5
			2.0	1.5	1.5	1.0	1.0	0.5	0.5
45			2.0	1.5	1.0	1.0	1.0	0.5	0.5
50									
	3.0	2.0	1.5	1.0	1.0	1.0	0.5	0.5	0.5
55	3.0	2.0	1.5	1.0	1.0	1.0	0.5	0.5	0.5
	2.5	2.0	1.5	1.0	1.0	0.5	0.5	0.5	0.5
60	2.0	1.5	1.0	1.0	0.5	0.5	0.5	0.5	0
	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
	1.0	0.5	0.5	0.5	0.5	0.5	0	0	0
75	1.0	0.5	0.5	0.5	0.5	0.5	0	0	0
	0.5	0.5	0.5	0.5	0.5	0	0	0	0
80	0.5	0.5	0.5	0.5	0.5	0	0	0	0
	0.5	0.5	0.5	0	0	0	0	0	0
85	0.5	0.5	0.5	0	0	0	0	0	0
	0.5	0	0	0	0	0	0	0	0
90	0.5	0	0	0	0	0	0	0	0

Hardness Value (HRB)	Diameter of Cylindrical Samples (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

6.2 Example of the hardness tester operation

- 6.2.1 Choose the standard block 30.8 HRB.
- 6.2.2 Plug the power cord (14) and turn on the switch (12). The indicator light on panel (5) is on.
- 6.2.3 Press **SC** button, choose scale **C** (scale **C** is automatically indicated by turn-on of the tester), the indicator lamp corresponding to total test pressure 1471N will light up. Turn the pressure selecting handwheel clockwise to ascertain that the total pressure is 1471N.
- 6.2.4 Press LD button, choose 5 seconds as the total test pressure holding time (automatically indicated by turn-on of the tester), then reset to zero.
- 6.2.5 Press No button, choose 5 as the times of operation, then reset to zero.
- 6.2.6 Select a diamond indenter according to the guideline in table 2. When install the diamond indenter (4), 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 (8), and place the sample on test stock (3).
- 6.2.7 Rotate the turn wheel (1) clockwise to let the lifting screw move upward, ensuring that the sample to be tested slowly contact with the indenter with no impact, till it reads 600 on digital display I. This indicates that the initial test pressure of 98.07N is achieved. Then the lifting screw will automatically lock with the turn wheel, and manual operation is completed by this time. (if upward movement

of the lifting screw is too quick to cause a reading over 610, the buzzer will sound to indicate the improper operation step, the operator shall lower the testing table, and choose a new test spot to make determination.) Motor starts to exert main test pressure automatically. When the total pressure is held for a predetermined period (10 seconds), motor will restarts to remove the main pressure and the initial pressure will last. Buzzer will sound and digital display I will show the hardness value of the tested sample.

- 6.2.8 Rotate the lifting wheel counterclockwise to lower the testing table. Repeat above procedure at various spots. 6 spots shall be tested for each sample (first spot will not be accounted).
- 6.2.9 After completion of predetermined times of operation, OVER indicator will light up, then lower the lifting screw. Depress button and “30.6” is shown on display I. This is the mean value of hardness determination results.
- 6.2.10 Depress **PR** button to print out the determined data. A sample sheet of print-out is shown as following:

R	0.5	←	Difference between max. and min.
HMIN	30.4	←	Minimum hardness in the 5 spots
HMAX	30.9	←	Maximum hardness in the 5 spots
AV	30.6	←	Arithmetic mean of the 5 spots
N	5	←	Operation times (actually N + 1)
AMOUNT			
05	30.9HRC	←	Tested values of each spot
04	30.7HRC		
03	30.6HRC		
02	30.4HRC		
01	30.5HRC	←	

6.2.11 Test operation is completed.

6.3 Adjustment of the hardness value display (figure 5)

If the structure and working principle of the tester apparatus are thoroughly understood, operator can make proper adjustment. 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 (25) clockwise, then tighten screw (26), make the test again until the displayed value falls in the specified tolerance (table 1). If displayed value is higher, turn screw (25) counterclockwise.

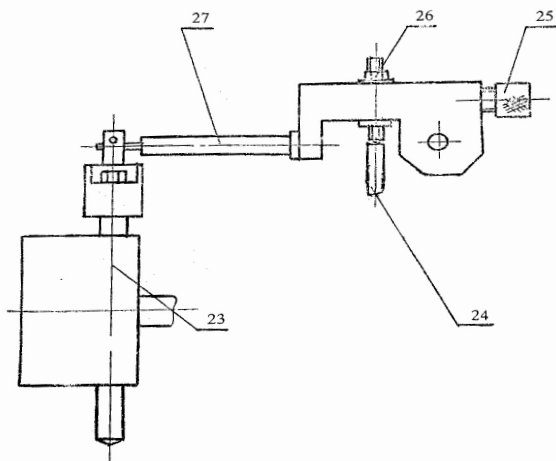


Figure 5

- | | |
|------------------------|------------------|
| 23 Displacement Sensor | 26 M4 Nut |
| 24 Indenter Rod | 27 Extension Rod |
| 25 Screw | |

6.4 Instructions for RS-232C communication line

6.4.1 Connect RS-232C communication line in accessory box with a computer (computer shall be power off) prior to power on the hardness tester. 9-pin adaptor shall be plugged to 9-pinhole socket on the tester, and 9-pin adaptor shall be connected to COM2 interface on the computer .

6.4.2 Power on the computer at first, then switch the hardness tester on. When the computer has entered WIN95/WIN98 interface, choose “start” → “program” → “accessory” → “communication” → super terminal (in case that the computer has not installed Super Terminal Program, please install the program in its Control Panel). At this

time point a super terminal window will be shown on win98 page. When double-clicking “Hypertrm”, an upgrading passage will appear. Choose “AA” in the field of name, for example, “for use when connected”; then choose “directly connected to serial interface 1” or “directly connected to serial interface 2” in the pulled-down menu, choose “9600” for Baud rate, keep others unchanged, and press “ENTER” to confirm and exit (after completion of the above preset operation, only a double-clicking on “AA” icon is needed to get the serial interface on-line). Thus the computer is at a connected state and waiting for data input.

6.4.3 According to the requirements in instruction manual, press “PRINT” button to print out, and the content of print-out is exactly the same as shown on the computer monitor.

7. Maintenance & Special Attentions

7.1 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.

7.2 A preheating of several minutes is needed after power-on of the hardness tester. For tester not frequently used, several pre-tests shall be done on the standard blocks after the tester is turned on. Actual test on samples can be carried out only when the display is stable.

7.3 Use of the standard blocks can only be done on their working surface. A minimum distance of 3 mm between two successive test spots is necessary. Life period of a standard block is limited to 2 years.

7.4 When handling the hardness tester, the extension rod shall be fixed, and the weights and hanger shall be removed. Power cord must be disconnected before removing weights/hanger and/or top cover.

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

7.6 Verification shall be done, at least once a year, on the tester so as to ensure its accuracy.

7.7 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	No power	Check if the power cord is properly connected.
	Fuse blows out	Replace the fuse.
Buttons do not function properly when tester is turned on	The apparatus is locked in a working state	Re-start the tester to reset the motor. Start operation after the buzzer stops.
Motor can not be stopped	1. Interference from outside circuit loop	Shut down the tester and lower the lifting screw.
	2. Operational error	Re-start after a while, the tester will reset automatically.
Extraordinary error occurs on display	1. Friction between weights and inner wall of the tester body caused by unlevelled installation of the tester.	6 Install the tester according to 4.2.4.
	2. Wrong order of weights placement	7 Place weights according to figure 3.
	3. Wrong selection of total test pressure or indenter.	8 Select appropriate test pressure (table 2)
	4. The dust-proof cover is higher than the supporting surface of the lifting screw.	9 Lower the dust-proof cover to below the upper surface of the lifting screw.
The printing paper gets stuck.	The roll of printing paper is too thick.	Outer diameter of the paper roll shall be < 40 mm

8. Notes for Hardness Tester Calibration Technician

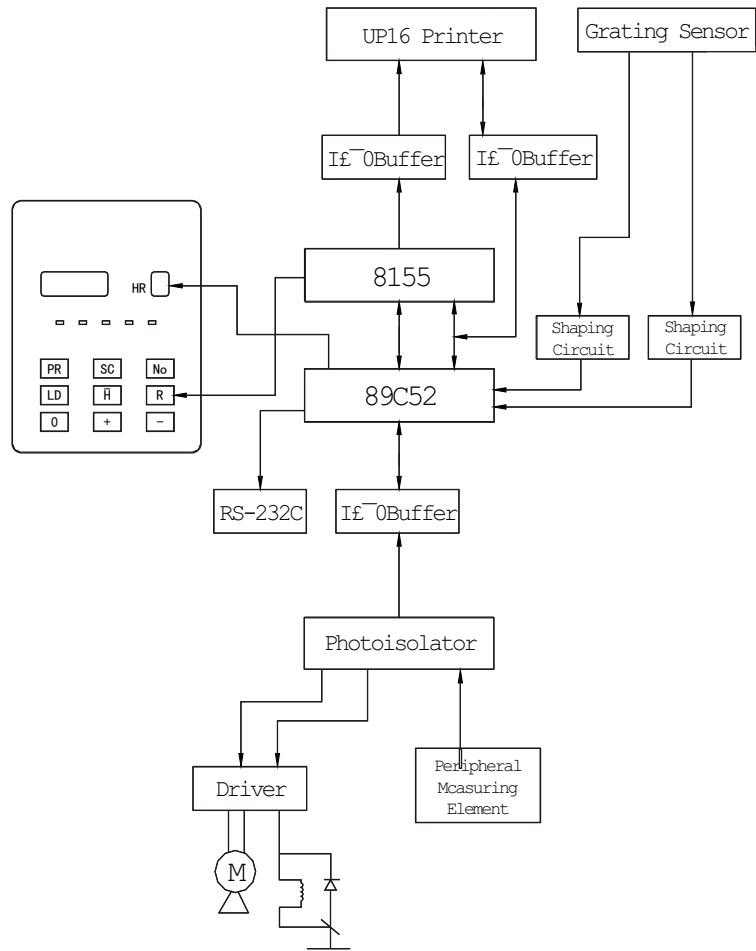
8.1 The tester has two operation modes: automatic and manual. The automatic mode is preset at factory.

8.2 In regular verification, the manual operation mode shall be selected. To do this, please open the top cover and place the 2-way switch on the PCB at “ON” position.

8.3 Under manual operation mode, the buttons on panel are no longer effective except for the following three, which however take on new functions in manual operation to facilitate the checking of test pressure.

- PR Press this button to start motor and charge the main test pressure.
- LD Press this button to start motor and relieve the main test pressure.
- 0 Set display values to zero.

9. Electrical Diagram



10. Accessories (Packing List)

The tester is supplied with the following accessories:

Item No.	Description & Specification	Quantity
1	Diamond Rockwell Hardness Indenter	1
2	Φ 1.5875 mm Ball Indenter	1
3	Test Tables of Large & Middle Size, V Type Test Table	3 in total
4	Weights A, B, C	3 in total
5	Standard Rockwell Hardness Blocks, HRB, HRC high, HRC low	3 (1 for each)
6	Power Cord	1
7	RS-232C Communication Line	1
8	Fuse 2A, 5×20	2
9	Printing Paper	1 roll
10	Dust-proof Plastic Bag	1
11	Lifting Screw Protecting Cover	1
12	Product Quality Certificate	1
13	ISH-DR150 Hardness Tester Instruction Manual	1
14	Printer Instruction Manual	1