



<b>Equipment Type</b>	Manual Rockwell Hardness Tester
<b>Model</b>	<b>OMEGA-RT2</b>
<b>Electrical Requirements</b>	N/A
<b>Frequency</b>	N/A
<b>Manual Revision Date:</b>	April 24, 2022

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Customer shall inspect the Products promptly upon receipt of delivery. Unless customer objects in writing within thirty (30) business days thereafter, customer shall be deemed to have accepted the Products. All claims for damages, errors, or shortage in Products delivered shall be made by Customer in writing within such five (5) business day period. Failure to make any claim timely shall constitute acceptance of the Products.

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This agreement has been made in and shall be governed by the laws of the State of Arizona. All disputes arising under or relating to the purchase of the equipment shall be brought and resolved solely and exclusively in the State of Arizona, Pima County. These terms and conditions and the description of the Products on the reverse side hereof or in any proposal submitted herewith constitute the entire agreement and understanding of the parties with respect to this sale and supersede all prior and contemporaneous agreements or understandings, inducements or representations, expressed or implied, written or oral, between the parties with respect hereto. Any term or provision of this Agreement may be amended, and any observance of any term of this Agreement may be waived, only by a writing signed by the party to be bounds. The waiver by a party of any breach shall not be deemed to constitute a waiver of any other breach. Should suit be brought on this Agreement, the prevailing party shall be entitled to recover its reasonable attorneys' fees and other costs of suit including costs and attorneys' fees incurred on appeal or in collection of any judgment., errors, or shortage in Products delivered shall be made by Customer in writing within such five (5) business day period. Failure to make any claim timely shall constitute acceptance of the Products.

**8. RESTOCKING FEE:**

All Returns are subject to a restocking charge equal to 15% (fifteen percent) of the Invoice, unless the Goods are proved to be non-conformed by PACE Technologies.

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## Precautions

1. Carefully read the Operation Manual before you use the hardness tester and get to know all of the operation procedures and usage precautions so as to avoid the damages to the hardness tester or operator.
2. All the straps and bands should be carefully removed before the hardness tester is installed and calibrated.
3. It is strictly prohibited to tamper with the installed position of all the electric component parts, switches, and sockets of the hardness tester without permission. Improper modifications will result in undesired results.
4. You should not turn the force knob or the Rotating Wheel during the loading and unloading operations or during the dwell time of the test force.
5. Our company tried to improve the quality of our hardness testers though upgrades and modifications. In the case that the contents in this manual are slightly different than the actual machine we apologize for any confusion.

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## 1. Introduction

- Material hardness is an important measurement characteristic for metals, ceramics and polymer materials. A material's hardness is related to its reliability, strength and wear resistance
- The OMEGA-RT2 hardness tester is a basic and simple to use instrument for use in the field of metallography. The OMEGA-RT2 is an ideal hardness testing instrument for technical colleges, universities and basic metallography laboratories.

## 2. Technical Data

### 2.1 Technical Data Table

Product Name	Manual Rockwell Hardness Tester
Model	OMEGA-RT2
Rockwell Scales	HRA, HRB, HRC, HRD, HRE, HRF, HRG, HRH, HRK, HRL, HRM, HRP, HRR, HRS, HRV
Preliminary Test Force	10Kgf(98.07N) Permitted Error: ±2.0%
Test Force	60Kgf(588.4N), 100Kgf(980.7N), 150Kgf(1471N) Permitted Error: ±1.0%
Loading Control	Manual Loading/Dwell/Unloading
Max. Height Of Specimen	6.9-inches (175mm)
Instrument Throat	6.5-inches (165mm)
Dimensions (WxDxH)	7.2 x 21.5 x 30-inches (182x546x755mm)
Packing Dimension (WxDxH)	18 x 24.5 x 32.25-inches (460x620x870mm)
Gross/Net Weight	198 lbs (90Kg)

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## 2.2 Working Principle

The Rockwell hardness test method consists of indenting the test material with a diamond cone or hardened steel ball indenter. The indenter is forced into the test material under a preliminary minor load  $F_0$  (Fig. 1A) usually 10 kgf. When equilibrium has been reached, an indicating device, which follows the movements of the indenter and so responds to changes in depth of penetration of the indenter is set to a datum position. While the preliminary minor load is still applied an additional major load is applied with a resulting increase in the penetration depth (Fig. 1B). When equilibrium has again been reached, the additional major load is removed but the preliminary minor load is still maintained. Removal of the additional major load allows a partial recovery, so reducing the depth of penetration (Fig. 1C). The permanent increase in depth of penetration, resulting from the application and removal of the additional major load is used to calculate the Rockwell hardness number.

$$HR = E - e$$

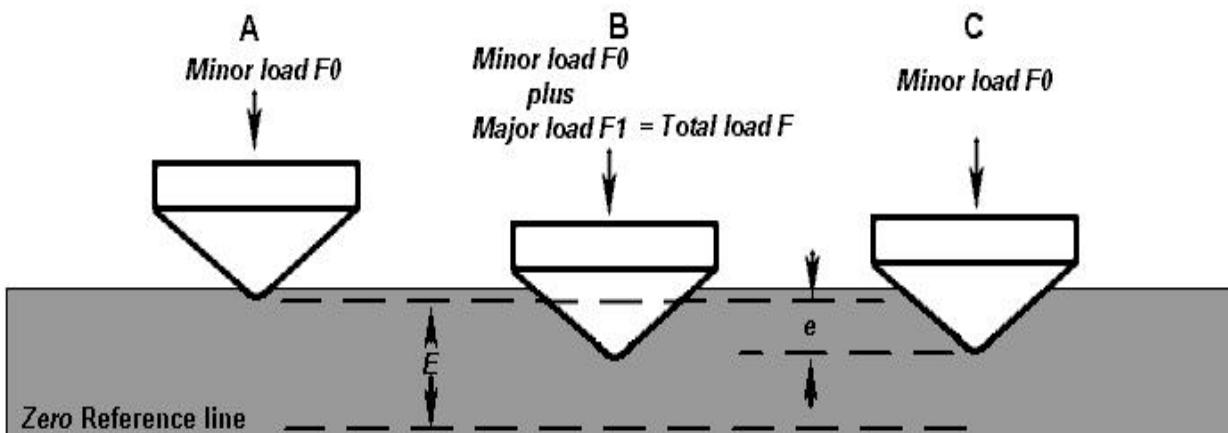
$F_0$  = preliminary minor load in kgf

$F_1$  = additional major load in kgf  $F$  = total load in kgf

$e$  = permanent increase in depth of penetration due to major load  $F_1$  measured in units of 0.002 mm

$E$  = a constant depending on form of indenter: 100 units for diamond indenter, 130 units for steel ball indenter

HR = Rockwell hardness number  $D$  = diameter of steel ball



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**1) Rockwell Scale, Indenter, Test Force and Applicable Range of the Rockwell Hardness Testing**

Hardness Scale	Hardness Symbol	Indenter	Initial Test Force F0 (N)	Main Test Force F1 (N)	Total Test Force F0+ F1 (N)	Application Range
A	HRA	120°Diamond Indenter	98.07	490.3	588.4	20 ~ 88HRA
B	HRB	1.5875mm Ball Indenter	98.07	882.6	980.7	20 ~ 100HRB
C	HRC	120°Diamond Indenter	98.07	1373	1471	20 ~ 70HRC
D	HRD	120°Diamond Indenter	98.07	882.6	980.7	40 ~ 77HRD
E	HRE	3.175mm Ball Indenter	98.07	882.6	980.7	70 ~ 100HRE
F	HRF	1.5875mm Ball Indenter	98.07	490.3	588.4	60 ~ 100HRF
G	HRG	1.5875mm Ball Indenter	98.07	1373	1471	30 ~ 94HRG
H	HRH	3.175mm Ball Indenter	98.07	490.3	588.4	80 ~ 100HRH
K	HRK	3.175mm Ball Indenter	98.07	1373	1471	40 ~ 100HRK

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### 3. Installation Steps

#### 3.1 Working Conditions

- 3.1.1 Under room temperature between 50-90°F (10~30°C).
- 3.1.2 The relative humidity in the test room ≤65%.
- 3.1.3 Limited vibration, corrosive medium or serious dust in the surrounding environment.

#### 3.2 Unpacking and Positioning

3.2.1 Cut the belts on the packing box, screw off the screws on the bottom plate of the box and remove off the upper body of packing box. Take out the accessories kit.

3.2.2 Unscrew the two (2) M10 outer hexagonal bolts under the bottom plate with a spanner, to separate the hardness tester from the bottom plate (take care of the safety).

3.2.3 After unpacking, the tester shall be placed on a stable and solid working table with horizontal deviation less than 1mm/m (There is a level in the accessories kit). A hole shall be drilled at a proper location on the working table (see Fig.1) to enable the Up and Down Lead Screw to operate properly.

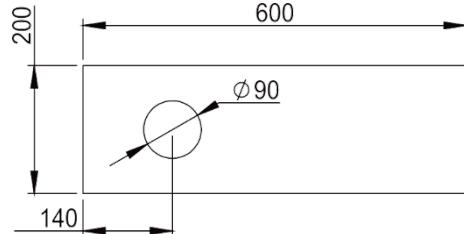


Fig 3-1

3.2.4 After the hardness tester is properly placed (Fig.2), open the Upper Cover (10) and the Back Cover (9). Untie the fastening rubber tape (Fig.13) on the Connecting Rod (23) and draw out the foam block under Protecting Gasket (26) and Lever (16). Untie all the white gauze on moving parts and then cover the tester to keep clean and free of dust.



1. Take care during unpacking and installation, avoid damaging the tester or parts.
2. After installation, please ensure no extra objects are left inside the machine.
3. Have a good knowledge of components structure and avoid incorrect operation.

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### 3.3 Components Illustration

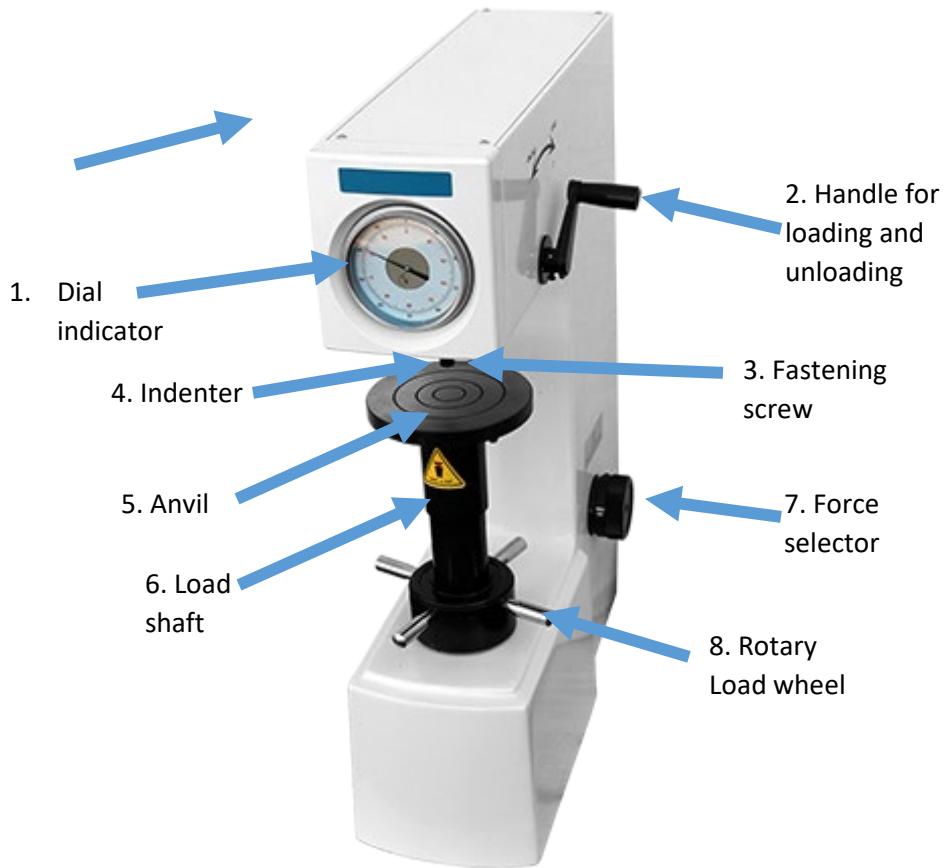


Fig. 2

Item Number	Description
1	Dial indicator
2	Handle for loading/unloading
3	Fastening screw for indenter
4	Indenter
5	Test anvil
6	Load shaft
7	Force selector
8	Rotary load wheel

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### 3.4 Weights Installation

3.4.1 During installation of weights, the instrument should not be in use.

3.4.2 Take the weight group out of the accessories kit and clean them thoroughly. Rotate the Load-Change Hand Wheel (7) to the place number 588, and then take the Hanging Rod (18) from the Back Cover and insert it in the hole of the Weight A (16), fasten the M10 Nut (17) at the tail of the Hanging Rod. Hook the Hanging Rod in the ear of the tail of the Lever (11). And then place the Weight B (15) and Weight C (14) separately on two Fork-Shaped Frames (13). At this point, rotate the Load-Change Hand Wheel clockwise for a whole cycle and observe the round pegs on both sides of the Weight and see if they are properly placed in the groove of the Fork-Shaped Frame. The Weights should not touch the inside wall of the instrument body (See Fig 3-2, 3-3).

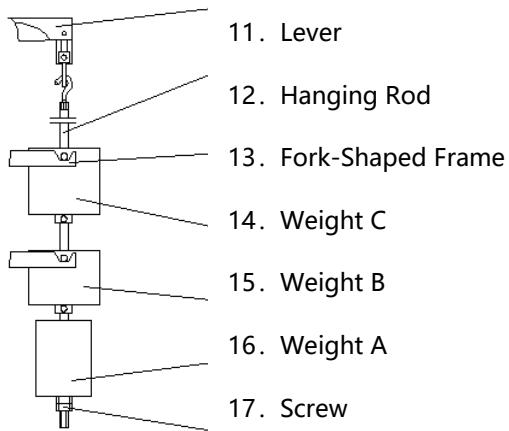


Fig 3-3

### 3.5 Weights and Force Table

Table 3

Scale	Test Force (N)	Graduated Value on Load-Change Hand Wheel	Force on the Weight(Weight Code)
HRA/ HR15	588.4(60kg)	588.4(60)	Hanging Rod +Weight A
HRB/ HR30	980.7(100kg)	980.7(100)	Hanging Rod+ Weight A+ Weight B
HRC/ HR45	1471(150kg)	1471(150)	Hanging Rod +Weight A +Weight B +Weight C

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## 4.0 Operation

4.0.1 The surface of the specimen should be smooth and clean without any feculence, oxidized peels, concaves or outstanding machining marks. The supporting plane of the specimen and the support anvil should be clean.

4.0.2 The Min. thickness of the specimen should be 10 times greater than the depth of the indentation. After the test, the back of the specimen should not have any visible signs of deformation (Fig.4-1).

4.0.3 The specimen should be fixed on the testing anvil. There should not be any movement of the specimen during the loading of test force or during the test force. The indenter should be loaded perpendicularly on the specimen.

4.0.4 The support anvil should be chosen according to the shape and size of the specimen. If the specimen has an irregular shape, a special holder should be made in accordance with the particular geometrical shape, so as to measure out correct hardness displaying values.

4.0.5 When the specimen is a bar, the V-shaped support anvil must be used. The results of the test should be revised. The revised values are all positive numbers. The revised values of the Rockwell Hardness Scales for the convex bar specimens are show in Appendix 1.

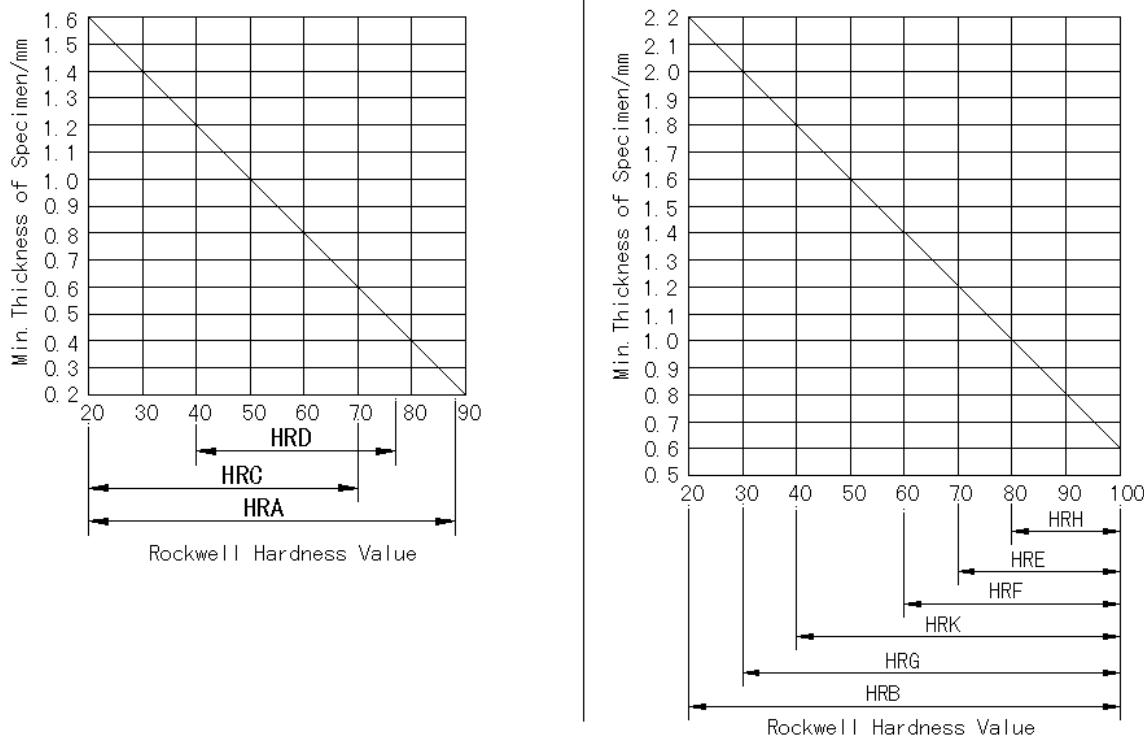


Fig 4-1 Min. thickness of specimen

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## 4.1 Operation Steps

4.3.1 Test the HRC standard hardness block by selecting the test force 1471N (150kg) and the diamond indenter according to Table 1. Rotate the Load-Change Hand Wheel clockwise to determine the total test force.

4.3.2 Push the Indenter (4) into the hole of the main spindle closely against the supporting plane and make the caved plane of the indenter handle face the screw. Fasten slightly the Fastening Screw of Indenter (3), and then place the hardness block on the Support anvil (5), see Fig 3-2.

4.3.3

- a. Ensure the “Load apply” handle (2, Figure 2) is set to the unloading position.
- b. Rotate the rotary wheel to the right so that the sample barely touches the indenter.
- c. Continue rotating the rotary wheel to the right until the small dial moves from the black dot to the red dot. Meanwhile the long hand should have rotated around the dial 3 times.
- d. Rotate the faceplate to align the “C” for Rockwell, or “B” for Brinell, with the long dial hand. This is your “0” position.
- e. Push the Load apply handle forward to the “loading” position. Count to 3 seconds.
  - i. During this step you are applying the total selected force to your sample.
- f. Pull the load handle backward to the, “unloaded” position.
  - i. You are no longer applying load to your sample but have your initial test force applied.
- g. The number that the long hand is pointing to is the hardness of your sample.
- h. Record the number.
- i. Rotate the rotary wheel to the left to lower the sample away from the indenter.
- j. Choose a new location on the sample to test and repeat the process until you are satisfied with your number of measurements.
- k. It is recommended to use at least 5 testing points per sample.

**DO NOT ATTEMPT TO MOVE THE SAMPLE WHILE A LOAD IS APPLIED.**

## 4.2 Calibration

### Method 1: Remove the Upper Cover

If the displaying value is less than the hardness value of the standard hardness block, fix the M4 Screw Rod (25) with a screwdriver and unscrew the nut one turn. Rotate the large thumb screw clockwise (26) a bit (half a circle is about 1 degree higher); and then fix the Screw Rod by fastening the nut. Perform the test until the value falls within the tolerance range (Table 3). If the displaying value is higher than the hardness value of the standard hardness block, rotate the Screw in the counterclockwise direction. (There is a screwdriver and spanner in the accessories kit)

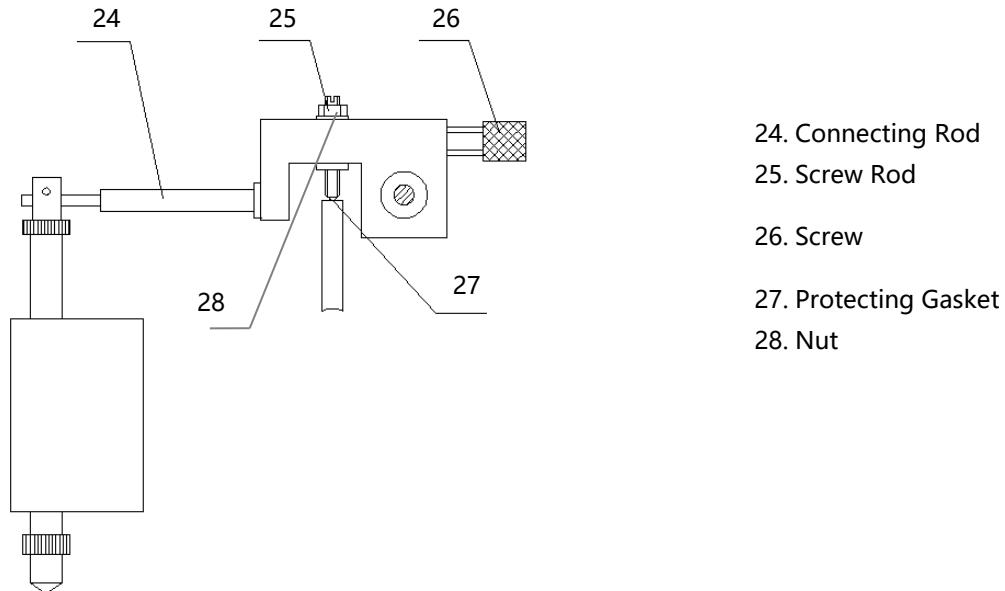


Fig 4-21

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## 5. Hardness Tester Maintenance

### 5.1 Operator

5.1.1 The operator should observe the operation and calibrate the instrument to a standard hardness block before and after testing. If the tester is rarely used, then several tests should be carried out to ensure the tester is calibrated before carrying out the necessary tests.

5.1.2 Gently rotate the lifting anvil when loading and unloading the force.

5.1.3 During testing (i.e. when loading and unloading the test force, or as the measurement dwell time is being carried out) do not turn the Load-Change Hand Wheel.

5.1.4 Only standard hardness blocks should be used on the working plane. Note the life time of the hardness blocks is 2 years.

5.1.5 Before the transportation of the tester, the Connecting Rod should be fixed. All the Weights on the Handing Rod should be unloaded as well.

### 5.2 Daily Maintenance

5.2.1 Keep the tester clean and cover the tester with an anti-dust bag after the test, lubricate the standard hardness blocks and ball indenters with the rust protecting oil to avoid rust.

5.2.2 Carry out periodic inspection of the tester, at least once a year in order to assure the correct operation of the tester.

5.2.3 Periodically add some lubricant on lead screw and inside of force knob.

### 5.3 Troubleshooting

5.3.1 When the hardness tester is in a non-working state, it is advisable to get in touch with the PACE Technologies service repair department prior to repair. The following troubleshooting issues are easily corrected without technical assistance (Table 6)

Table 6

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Phenomenon	Problem	Solution
The dial needle is not zeroed	Out of alignment	Refer to page 14 and loosen the nut to rotate the thumbscrew (23) until the dial points to the zero. Secure the screw by fastening the nut.
There dial jumps aggressively during the loading of the test force. (Or there sounds like there is a leak)	The oil volume is not sufficient in the container.	Add oil to the oil pot around the indenter.
The Up and Down Lead Screw is blocked	The space between the Up and Down Lead Screws is too small and they are blocked by the thread ends or feculence	Remove the protecting cover of the Up and Down Lead Screw and clean the screw
The deviation of the displaying hardness value is too great.	1 The indenter is damaged 2 The Weights are not installed in order. 3 The tester is not placed in the horizontal level and the weights touch the inside wall of instrument body. 4 The total test force or the indenter is wrong. 5 The protecting cover of Up and Down Lead Screw is high over the supporting plane of the Support anvil	1 Change the diamond indenter or the ball indenter. 2 Install the weights according to Fig.3 3 Calibrate the tester with a level according to section 3.2.3 4 Select the testing force and the indenter according to the requirements in Table 1 5 Lower down the protecting cover of the Up and Down Lead Screw.

## 6. Storage/Transportation Attention

Storage should be in an area with where there is minimal vibration, corrosion, moisture, dust, and be stored at room temperature and humidity. For shipping and transportation it is best to use original packing box to avoid any damage.

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### Appendix 1 (Hardness Value Corrections For Testing On Convex Cylindrical Surfaces)

Corrections to be added to Rockwell B, F, and G Values Obtained on Convex Cylindrical Surfaces of Various Diameters

Table A-1

Hardness Value (HR)	Diameters of Convex Cylindrical Surfaces (mm)						
	6	10	13	16	19	22	25
	Corrections to be Added to Rockwell B, F, and G Values (HR)						
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

Corrections to be Added to Rockwell A, C, and D Values Obtained on Convex Cylindrical Surfaces of Various Diameters

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Table A-2

Hardness Value (HR)	Diameters of Convex Cylindrical Surfaces (mm)								
	6	10	13	16	19	22	25	32	38
	Corrections to be Added to Rockwell A, C, and D Values (HR)								
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

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**Appendix 2 (Allowable Repeatability and Error Table)**

Rockwell Scales	Hardness Range	Max Error
HRA	(20 ~ 75)HRA	±2HRA
	( > 75 ~ 88)HRA	±1.5HRA
HRB	(20 ~ 45)HRB	±4HRB
	( > 45 ~ 80)HRB	±3HRB
	( > 80 ~ 100)HRB	±2HRB
HRC	(20 ~ 70)HRC	±1.5HRC
HRD	(40 ~ 70)HRD	±2HRD
	( > 70 ~ 77)HRD	±1.5HRD
	( > 90 ~ 100)HRE	±2HRE
HRF	(60 ~ 90)HRF	±3HRF
	( > 90 ~ 100)HRF	±2HRF
HRG	(30 ~ 50)HRG	±6HRG
	( > 50 ~ 75)HRG	±4.5HRG
	( > 75 ~ 94)HRG	±3HRG
HRH	(80 ~ 100)HRH	±2HRH
HRK	(40 ~ 60)HRK	±4HRK
	( > 60 ~ 80)HRK	±3HRK
	( > 80 ~ 100)HRK	±2HRK
HRE	(70 ~ 90)HRE	±2.5HRE
HRL	(100 ~ 120)HRL	±1.2HRL
HRM	(85 ~ 110)HRM	±1.5HRM
HRR	(114 ~ 125)HRR	±1.2HRR