



[www.insize.com](http://www.insize.com)



## **OPERATION MANUAL**

**Model ISH-PB  
Portable Brinell Hardness Tester**



## 1. Introduction

This hardness tester is a portable type Brinell hardness tester. It is designed in accordance with the dynamic hardness testing method. The advantages of the tester are as following: (compare with the static load fixed Brinell hardness tester).

1. The tester is small, compact and light(net weight 3.33kg), easy to operate, and it takes the advantage of large materials or components hardness testing.
2. Its construction is simple, so it's easy to produce and low cost.

## 2. Application Range

This hardness tester is used to measure the Brinell hardness number of metals with elastic modulus of 2 approximately. The tester is available for metallurgical and mechanical factories.

The accuracy of the hardness tester is  $\pm 8\%$ . Its measuring range is HB100-400. The corresponding tensile strength ( $\sigma_b=0.33HB$  approximately) are listed in Table 3.

## 3. Description Of Mechanism

The construction of the hardness tester is as following: (see Fig. 1)

1. Steel tube -- It's the body, and used to converge individual components;
2. Penetrator -- It's used to fix steel ball which impacts against the specimen.  
It ensures the steel ball unmovable during the test is carrying on;
3. Push rod -- It transmits the impact energy to steel ball;
4. Impact hammer -- It composites with a working spring, and provides impact energy of 0.5kgm;
5. Working spring -- It provides impact energy with the hammer;
6. Hooks -- They're used to hook the hammer and compress the spring to provide impact energy;
7. Hooks seat -- It's used to support the hooks and push rod;

8. Connecting nut -- It's used to adjust impact energy;
9. Square threaded nut -- It's set in the connecting support square threaded nut, and used to adjust the coefficient of elasticity of the spring and support the contactor;
10. Contactor -- It's set in the square threaded nut. It acts to ensure two hooks release at once.  
Other components are used with those mentioned above to ensure the working performance of the apparatus.

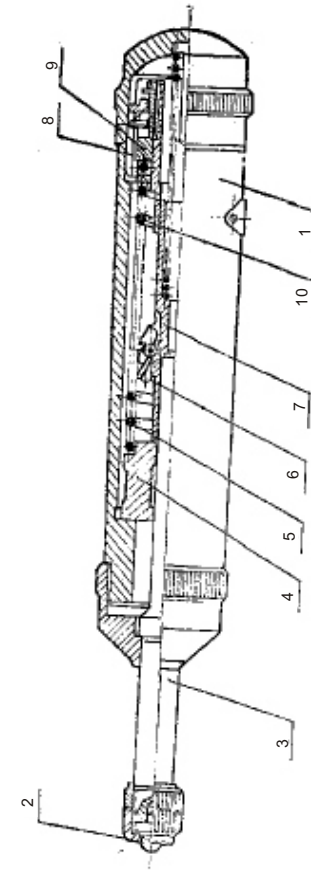


Fig. 1

#### 4. Operation And Maintenance

##### 1. Method of operation:

- (1) Clean the foul accumulated on the steel ball, the lock nut of penetrator, the check nut and the body before operation, then tighten the penetrator and steel ball on the push rod.
- (2) The surface of the test piece should be flat and smooth, and free from oxide scales, decarbonized layer and hardening performance. The surface finish should be such that it will make the edge of indentation fairly clear.
- (3) Thickness of the test piece should be at least 10 times the depth of the steel ball indentation (see Table 1). Specimens should not be elastic components. The distance between the centers of two adjacent indentations should not be less than 4 times the diameter of the indentation, and the distance from the center of indentation to the edge of the test piece should not be less than 2.5 times the diameter of the indentation.
- (4) If the volume of the specimen is too small, it may be fixed on a large plane station, pay attention that no movement is derived while the impact is carrying on.
- (5) In order to eliminate the contact interspace between the push rod and the steel ball penetrator, impact several points before the test begins. In operation, the steel ball penetrator should be perpendicular to the surface of the specimen. While impacting, hold the steel tube with one-hand, and the other hold the rear cover. The steel ball penetrator is to be aimed at the specimen, and the push rod moves in the steel tube, until the contactor forces the hooks to release, and impact is complete.
- (6) Measure the diameter of impression from two perpendicular directions and take the average value. The deviation between two measured diameters shouldn't exceed 2.96. The measured diameters should be included in Table 2.
- (7) Make three impressions on a specimen, measure their diameters and take the average value. Refer to Table 2 for the hardness number corresponding to the measured diameter of impression. If the deviation of the diameter of impressions exceeds 0.1mm, it is undesirable, so another impression instead of that one.

##### 2. Directions of maintenance

- (1) The sliding part of the instrument must be lubricated regularly with No. 1 spindle oil or sewing machine oil. Remove the rear cover to fill lubricant, other parts are not permitted to. If the internal components are damaged, remove working spring (5), connecting nut (8) square threaded nut (9) and contactor (10) altogether. Beware of dismounting the above four components separately, in order to keep the coefficient of elasticity of the working spring constant. If these four components proved themselves unweared after inspection, set them in original position. If they are worn and torn, exchange and readjust them. Then they may be used after inspection.
- (2) If the tester is not used for a long time, it is recommended to dismount the penetrator and steel ball. Pack them with a box after they are cleaned and coated with Vaseline to avoid corrosion.

**Table 1**

The selection of Brinell hardness number, diameter of steel ball and thickness of test-piece.

Range of Brinell Hardness Value (HB)	Diameter of Ball D(mm)	Thickness of Test-piece(mm)
100-200	10.0	>8
> 200-300	10.0	6-8
> 300-400	10.0	5-7

**Table 2**  
The conversions of diameter of impression and Brinell hardness number

diameter of impression d	HB Φ10	diameter of impression d	HB Φ10	diameter of impression d	HB Φ10
2.66	440	3.08	248	3.50	149
2.68	427	3.10	242	3.52	145
2.70	415	3.12	236	3.54	141
2.72	404	3.14	230	3.56	137
2.74	393	3.16	225	3.58	133
2.76	382	3.18	220	3.60	130
2.78	371	3.20	215	3.62	127
2.80	361	3.22	210	3.64	124
2.82	351	3.24	205	3.66	121
2.84	341	3.26	200	3.68	118
2.86	331	3.28	196	3.70	116
2.88	322	3.30	191	3.72	113
2.90	313	3.32	187	3.74	110
2.92	305	3.34	182	3.76	108
2.94	297	3.36	178	3.78	106
2.96	289	3.38	173	3.80	104
2.98	282	3.40	169	3.82	102
3.00	275	3.42	165	3.84	100
3.02	268	3.44	161	3.86	98
3.04	261	3.46	157	3.88	96
3.06	254	3.48	153	3.90	94

**Table 3**  
The conversion of tensile strength and Brinell hardness number

HB	$\sigma_{b \approx 0.33HB}$	HB	$\sigma_{b \approx 0.33HB}$	HB	$\sigma_{b \approx 0.33HB}$
278	100	217	78	156	56
272	98	211	76	150	54
266	96	205	74	144	52
261	94	200	72	139	50
255	92	194	70	133	48
250	90	189	68	128	46
244	88	183	66	122	44
239	86	178	64	117	42
233	84	172	62	111	40
228	82	167	60	106	38
222	80	161	58	100	36

## Reading Microscope Manual

### 1. Application

This reading microscope is one kind of the optical measuring instrument. It has the advantages of simple structure, easy manipulation and wide usages. It can be used to measure the distance between holes, width of engrave, distance of engrave, width of key slot, width and length of slit and concavity, outlook quality of metals, density of fiber, textile and the field specimens. The best usage of this instrument is to measure the indentation dimension impressed by Brinell Hardness Tester.

### 2. Specification

- 1) Objective magnification 1X
- 2) Objective focus 31.48mm
- 3) Eyepiece magnification 20X
- 4) Eyepiece focus 12.6mm
- 5) Microscope magnification 20X
- 6) Working distance 62mm
- 7) View field diameter 9mm
- 8) Effective measuring range 6mm
- 9) Eyepiece division plate value 1mm
- 10) Eyepiece division plate scores 6 lines
- 11) Micrometer thimble min. value 0.01mm
- 12) Measuring accuracy 0.01mm

### 3. Structure And Working Principle

#### 1) Optical system (see Fig.1)

When the object surface 7 is illuminated by the natural or artificial light, the reflected beams come through the objective 6 and image is formed on the upper division plate 4, it comes through the eyepiece 2 forms the image on the retina of the observer.

#### 2) Structure and working principle (see Fig .2)

This reading microscope consists of the micrometer eyepiece group 9, objective group 1, tube 20 and tube stand 22. In the micrometer eyepiece group, on the focal surface of the eyepiece fixed the upper division plate 8 with the scale from 0 to 6mm, one graduation equals to 1 mm. The scored surface of the division plate is downwards (relative to the eyepiece). Under the upper division plate, mounted the lower division plate 13, the distance between the two plates is allowable in the range from 0.02 to 0.05mm. On the surface towards the eyepiece engraved vertically two long scores.

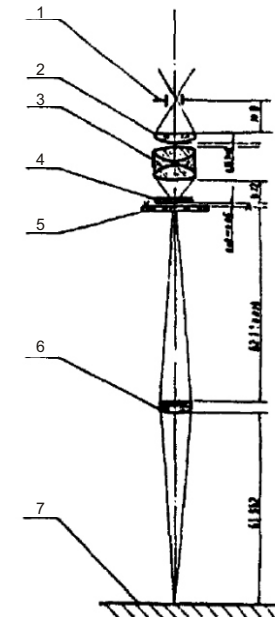


Fig.1 Optical System

- |                         |                         |
|-------------------------|-------------------------|
| 1. Eye pupil            | 5. Lower division plate |
| 2. Eyepiece             | 6. Objective            |
| 3. Field lens           | 7. Object surface       |
| 4. Upper division plate |                         |

The Lower division plate 13 is firmly connected to the lower division plate seat 15. The seat 15 may be moved axially along the micrometer screw 4 of the graduation thimble 7. The smooth movement of the seat 15 is guaranteed by the finely worked slide 16, dovetail slot 2, spring 14, as well as the proper fitting between the micrometer screw 4 and the open nut 3 in the graduation thimble 7. When the graduation thimble 7 is turned clockwise, the micrometer screw makes the seat 15 together with the lower division plate 13 move towards the left. When it is turned reversely, the spring 14 will move the seat 15 together with the lower division plate 13 towards the right.

The micrometer screw's pitch is 1mm, which is equal to the value of the upper division plate 8, therefore, when the graduation thimble turns one cycle, the long score on the lower division plate 13 will move one measure against the upper division plate. Thus, the integer may be read out the upper division plate. The graduation thimble is of centigrade, therefore, one grade equals to 0.01mm and the whole reading is the integers on the upper division plate plus the grade on the graduation thimble.

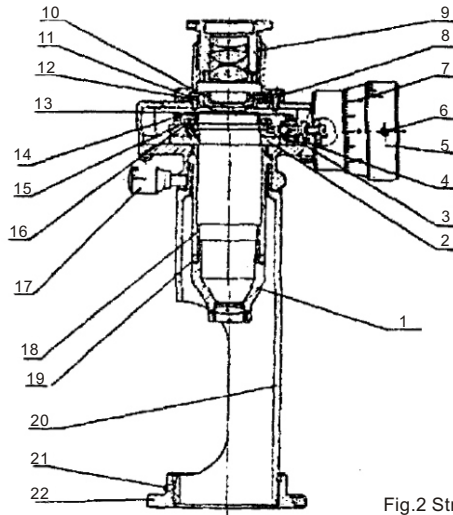


Fig.2 Structure

1. Objective Group 2. Dovetail Slot 3. Open Nut 4. Micrometer Screw 5. Turning Wheel 6. Set Screw 7. Graduation Thimble 8. Upper Division Plate 9. Micrometer Eyepiece Group 10. Division Plate Frame 11. Fix Screw 12. Division Plate Seat 13. Lower Division Plate 14. Spring 15. Lower Division Plate Seat 16. Slide 17. Lock Screw 18. Objective Tube 19. Objective Spacer 20. Tube 21. Set Screw 22. Stand

#### 4. Method Of Usage

Put the instrument on the test piece to be measured and illuminate it using the natural or artificial light, then adjust the eyepiece knob to make the division plate scores and the object in the view field both clear simultaneously.

When measuring, put the instrument on the indentation impressed for measuring and make one of the scores (2) on the upper division plate contact one side of the impressed indentation, then turn the graduation thimble to move the lower division plate and make the long score contact the other side of the indentation (between 4 and 5), see Fig.3.

Reading out:

- 1) The integer taken from the upper division plate is 2.
- 2) The centigrade taken from the graduation thimble is 65 (see Fig.4) since one grade equals to 0.01mm, therefore, 65 equals to 0.65mm, i.e.  $0.01 \times 65 = 0.65(\text{mm})$ .
- 3) The dimension of the indentation measured should be:  $2 + 0.65 = 2.65(\text{mm})$ .

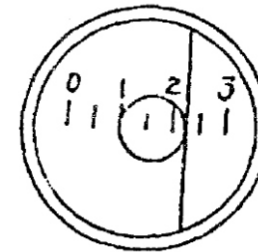


Fig.3 Example of measuring

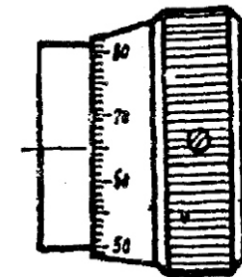


Fig.4 Graduation thimble

## 5. Calibration

- 1) Alignment of tire zero positions of the graduation thimble and the upper division plate.

First, loosen the three set screws 6 on the graduation thimble 7, and then make the vertical long score in the view field coincide with the zero score on the upper division plate. Then turn the graduation thimble 7 and make the zero score coincide with the mark line. When all is proper aligned, retighten the three set screws. The calibration is finished.

- 2) Objective image size calibration

Between the objective group 1 and the objective tube 18, the spacer ring of proper thickness is used to make the image size coincide with the standard scale. This calibration had before exfactory and no further calibration is necessary during manipulation.

- 3) Calibration of the object distance

Put the instrument on the surface to be measured, then observe through the eyepiece to see the image on the division plate is clear or not, if the eyepiece to see the image on the division plate is clear or not, if not, loosen the set screw 21 on the tube stand 22 and turn the tube stand 22 against the tube until the image on division plate is clear, then retighten the 21. The calibration is finished.

## 6. Maintenance

- 1) Never disassemble the instrument during manipulation, otherwise, the accuracy will be impaired.
- 2) The instrument should be stored in dry place, well ventilated and free from erosive medium.
- 3) If the lease contaminated, it may be cleaned with soft material, such as absorbent cotton, soft brush and lens paper. If contaminated by grease dirt, it may be cleaned carefully with absorbent cotton soaked with the mixture of ether and ethanol.

## 7. Overall Dimension And Weight

Overall dimension(L×W×H): 70×50×155mm

Net weight : 0 .5kg

Weight(include box and accessories): 1kg

Dimension of box (L×W×H): 180×90×60mm