

PHB-200 MAGNETIC DIGITAL BRINELL HARDNESS TESTER



Shenyang TX Testing Instruments Inc.

Add.: 17-1 Wensu Street Hunnan District
Shenyang 110168 China
Tel: +86-24-24200002
Fax: +86-24-24230008
Web site: www.txinstruments.com
E-mail: export@txinstruments.com



Shenyang TX Testing Instruments Inc.

www.txinstruments.com

Content

1. Safety	1
1.1 On Dropping of the Tester	1
1.2 On Strong Magnetic Field	1
1.3 On Recharger	2
2. General Description	2
3. Working principle and Structure	3
4. Main Technical Parameters	7
5. Buttons Illustration	7
6. Test Operation	8
6.1 Preparation before testing	8
6.2 The Tester' s attachment to test part	8
6.3 Start	8
6.4 Time Duration Setup	8
6.5 Operation Steps	9
6.6 Acceptable range of test force	9
7. Inspection of Tester	9
7.1 Acceptable Indication Error and Repeatability Error	9
7.2 Indication Values Inspection	10
7.3 Inspection of Brinell Hardness Tester	11
8. Calibration of Force Values	11
8.1 Condition for Starting Force Values Calibration	11
8.2 Ways of Force Values Calibration	12
9. Misoperation, Faults and Solution	13

10. Factors Affecting Test Accuracy	13
11. Parts Introduction	14
12. Other Instructions	17
13. Standard Package	19
Appendix	

1. Safety

Before operating the instruments, please read and make a thorough understanding of the instruction on safety.

1.1 On Dropping of the Tester

The tester is made of iron and steel, leading to a heavy weight, therefore if dropped by accident; it could cause injuries to persons and severe damage to the instruments. Thus, please follow the safety precautions below strictly:

1.1.1 Place it in a plain and steady location when it is unused, in case of falling.

1.1.2 Move the tester cautiously, in case of falling down from hands.

1.1.3 Hold the tester firmly when testing a part with curved surface or tilted, especially when the magnetic switch is off, in case of potential injuries to persons.

1.1.4 Fix the iron seat of the tester in a steady place, in case of falling.

1.2 On Strong Magnetic Field

It could cause strong magnetic field in using. When you close the magnetic switch, magnetic field inside the hardness tester shows a closed loop, no magnet to outside. When the magnetic switch is on, tester affects magnet to outside. It equals to a strong magnet at this time. If by carelessness, tester would dash to the surrounded iron and steel products, and in this process it would cause possible injuries to persons and damage to tester. Thus in the stocking and operating of tester, please follow the regulations below strictly:

1.2.1 Only when the tester placed plainly and steadily, push the magnetic switch to “ON” . On any other occasion, the magnetic switch is “OFF”

1.2.2 In the process of loading, if the suction is not strong enough, tester may leave the testing part, at this time the magnetic switch should be “OFF” .

1.2.3 It is easy to push the magnetic switch to “ON” , when it is placed in iron seat or suitable iron and steel test parts, so when the operator feel hard to do this, DO NOT do it by force. The operator should investigate the reasons and secure

the safety of operation.

1.3 On Recharger

The tester supplies recharger which should be used following the instruction. Furthermore, one should also follow the below instructions:

1.3.1 The recharger could only be applied to regulated power on the body of tester.

1.3.2 Keep away from water or other liquids when recharging.

1.3.3 Do not touch the connector plugs in wet hands.

1.3.4 Do not disassemble the recharger, avoiding of electric shock.

2. General Description

PHB-200 Magnetic Digital Brinell Hardness Tester uses conventional Brinell hardness test method to make hardness testing.

The instrument directly use the Brinell hardness test principle, using 187.5kg test force, 2.5mm ball indenter, pressing a precise Brinell hardness indentation on the work piece, and then use reading microscope or Brinell indentation measuring system to get the diameter of the Brinell indentation; you can get an accurate Brinell hardness value. The accuracy complies with ISO6506.2.

The instrument has good stability and repeatability, which can achieve reliable value transfer. It can replace lower accuracy Hammer Brinell hardness tester and lower precision and reliability Richter hardness at the time of testing more important parts.

3. Working Principle and structure

The tester consists of two magnetic chucks and one intelligent hardness test unit. The instrument is fixed on the iron and steel part through its two magnetic chucks when testing. The operator loads test force by hand wheel, and the force sensor detects the force simultaneously and displays the test force value on the screen. After the load force is released and the indenter is lifted for a suitable distance, there is a Brinell indentation, using the microscope to read the diameter of the Brinell indentation and then the hardness value can be obtained by looking up the table.

Physical appearance and names of parts refer to Figure 1 and Figure 2.

Operation and display screen refer to Figure 3.

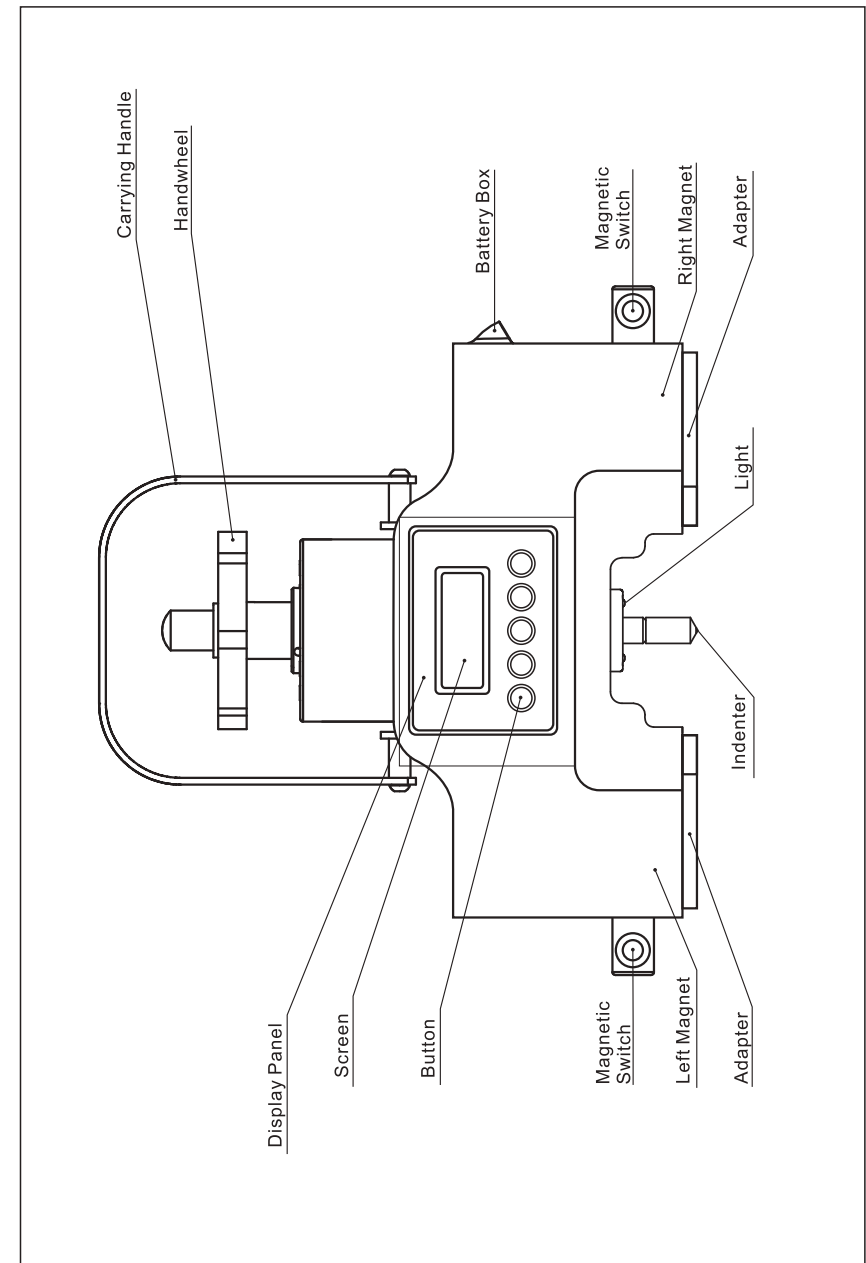


Figure 1. Front View of Instrument

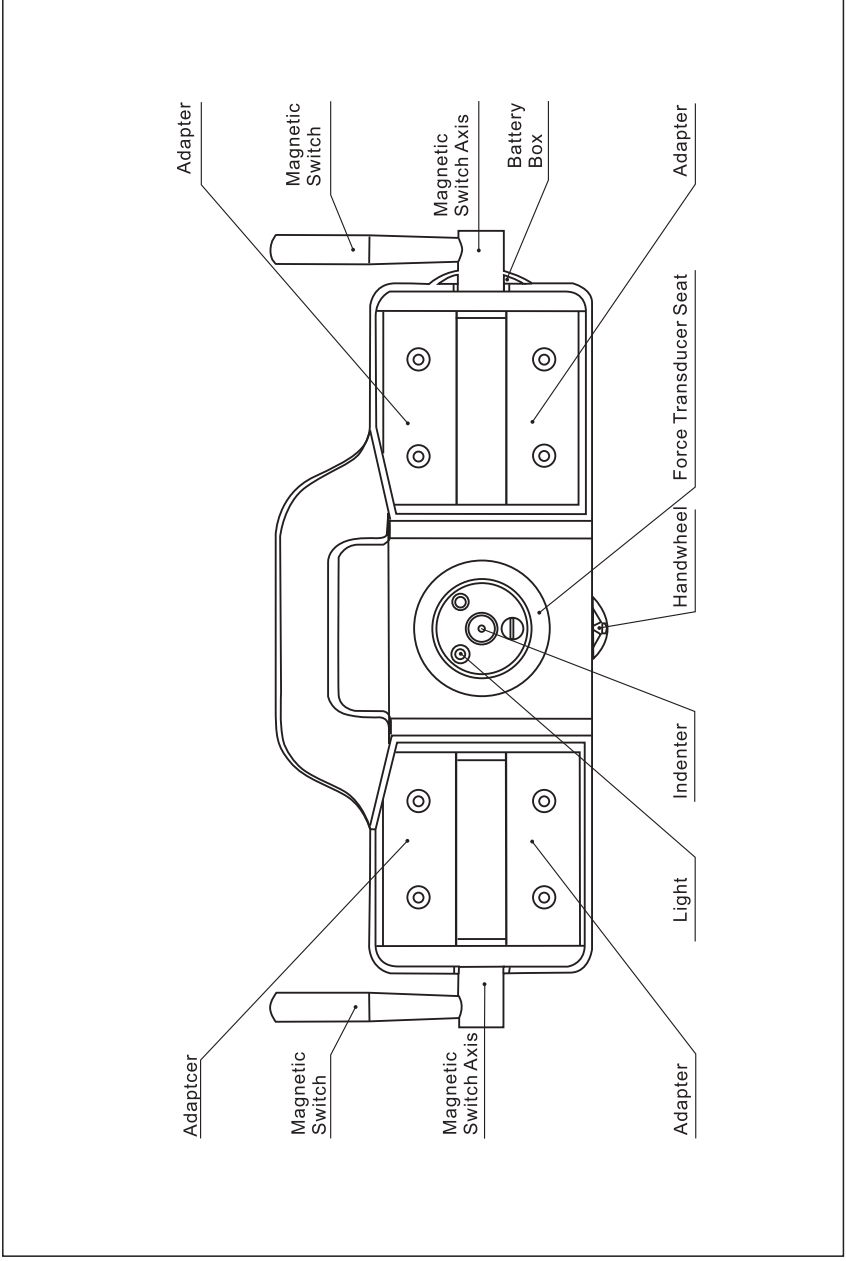


Figure 2. Bottom View of Instrument

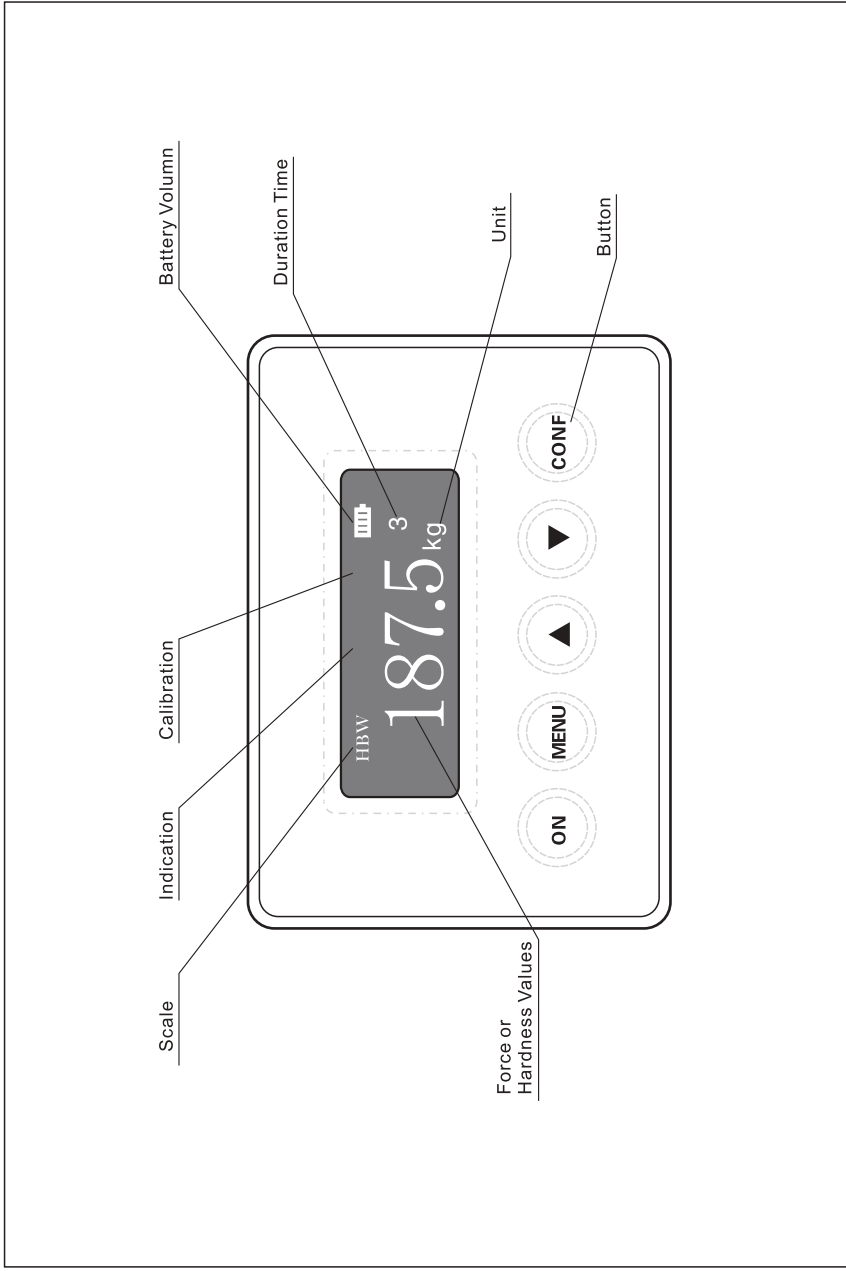


Figure 3. Keyboard and Screen

4. Main Technical Parameters

Total Test Force:	187.5kgf
Test force tolerance:	$\leq \pm 1\%$, complying with ISO and ASTM standards
Indenter:	2.5mm carbide ball
Test Range:	100~650HBW
Indicator Error:	Complying with ISO and ASTM standards
Repeatability Error:	Complying with ISO and ASTM standards
Operation Temperature Range:	5~45°C
Weight:	5.1kg
Dimension:	245mm(L) × 105mm(W) × 238mm(H)
Min. Measure Surface:	Flat: Area $\geq 195\text{mm} \times 60\text{mm}$ Thickness $\geq 5\text{mm}$ Cylinder: $\phi 60\text{mm} \times 200\text{mm} \times 8\text{mm}$

5. Buttons Illustration

“ON” It is to turn on or off the instrument. After the instruments without using more than three minutes, the power will be turned off automatically.

“MENU” It is to set the functions of the instruments. After pressing “Menu”, the instrument is on status and the menu displaying, then press “Menu” again, it would be on next level menu.

“△” On status of set-up, it could move the arrow upward; on the status of time set-up, press “△”, it could increase time keeping.

“▽” On status of set-up, it could move the arrow downward; on the status of time set-up, press “▽”, it could decrease time keeping. “CONF” On status of set-up, it could enter the set result and end up the set status.

6. Test Operation

6.1 Preparation before testing.

Sand the test part until it is flat and smooth. It is forbidden to have scale, decarburized layer, steel pit or dust on the surface of the part.

Caution:

Please check the position of the indenter before testing. The pointed end of the indenter must be higher than the bottom surface of the tester to ensure there would be no touch with the test part. Otherwise, the indenter would be damaged.

6.2 The tester's attachment to test part

The tester should be attached to test part flatly and steadily with the indenter erected to the surface of test part. Turn the magnetic switch to “On”, keeping the tester fixed onto the test part.

6.3 Start

Pressing “On”, after displaying the company info, it would display “0.0kg” and then be on test status. At this moment, it could directly test or run into set-up status by pressing “Menu”.

6.4 Time Duration Setup

Time duration of test force will affect test accuracy and efficiency. In certain range, longer duration, higher accuracy can be got, but with lower efficiency. Generally, it should keep long time for accuracy test, such as test the hardness blocks. For example, choose 10 seconds. For quick onsite test choose shorter time, operators should consider the accuracy and efficiency to set the time duration, the method is following:

Press “Menu” into setup status, menu displays on screen.

Press “△” or “▽” to move the arrow at “Time Duration”.

Press “Menu” into time duration setup status.

Press “△” or “▽” to adjust time values.

Press “Enter” continuously, until back to test status.

6.5 Operation Steps

Turn the hand wheel to load test force steadily, observing the screen, when the test force reaches 187.5kgf, please stop or replenish the test force slowly to try to keep the test force around 187.5kgf, now the time counting down will displays on the right of the screen. When the time counting down finished, please turn the hand wheel reversely to release test force steadily. Then one full operation is accomplished.

Move the tester after testing and read the indentation diameter by reading microscope, and then look-up the chart to find the Brinell value. Or you can use Brinell Indentation Measuring System to read the hardness value directly.

Notes:

1. Time counting down is the minimum time duration set, in testing procedure test force it should be held until time values disappeared, otherwise the screen will display “Hold Not Enough”, the test is not effective.

2. It is better to load the total test force in one time, without any pause.

6.6 Acceptable Range of Test Force

For guarantee the test accuracy, it sets the acceptable range of test force. During loading and holding test force, it should be within the acceptable range. Regarding the scales of Brinell hardness, the total test force can be set in the range of 187~190kgf. When loading and holding test force, if it is higher the maximum value, “Over load” will display on the screen; if it is lower than minimum values, “Underload” will display on the screen.

If occur above phenomenon, it should be unload the test force totally, and make a new test on new position.

7. Inspection of Tester

Iron seat and hardness block will be used during inspection.

7.1 Acceptable Indication Error and Repeatability Error

Tester complies with standard of ISO6506.2. The requirements for the accuracy in the regulations please see Table-1.

The acceptable error of the tester includes two parameters, indication error and repeatability error. Indication error means the differences between average hardness values after test several times and the marked hardness values on block should be within the acceptable range. Repeatability error means the differences between maximum and minimum values within the acceptable range.

If the error is not in acceptable range, firstly the operator should check whether the operations method is right. Please try to make the same test force loading condition each time, that is, make the same loading process, peak of test force, force holding, time duration, and releasing process as much as possible.

Due to manual test force loading, it is hard to make the same process each time, and the man-made error is inevitable. It is important to operate carefully and skillfully to minimize man-made error.

Table-1 Acceptable error of Brinell Hardness Tester

Hardness Range	Acceptable Indication Error	Acceptable Repeatability Error
$\leq 125\text{HBW}$	$\pm 3\%$	$\leq 3.5\%$
125~225HBW	2.5%	$\leq 3.0\%$
$\geq 225\text{HBW}$	2%	$\leq 2.5\%$

7.2 Indication Values Inspection

The indication values should be inspected frequently. A thorough inspection should be taken at regular intervals like 1 month; and a daily inspection should be taken everyday before operation or when the accuracy is unsure.

All the blocks with tester will be inspected at regular intervals inspection. The error should comply with there levant standards.

Only block with similar hardness to test-piece will be inspected in daily inspection. The error should comply with the relevant standards.

7.3 Inspection of Brinell Hardness Tester

Iron seat is required in inspection of the hardness block. Hardness blocks and iron seat should be clean. Any dust or contaminant will cause additional error to measurement.

Put the iron seat on horizontal plane desk with concave upwards, and then lay on the tester, making the indenter aiming to the center of the iron seat. Switch on the magnetic system, the tester will be absorbed on the iron seat, put hardness block on the concave. At this time, there should not be touch between the indenter and the block.

Turn the hand wheel steadily to load test force, when it appears 187.5kgf on screen, hold the test force until time counting down finished or even longer.

Reverse hand wheel steadily to release test force until hardness values display "0" on screen. Remove the instrument, read the indentation diameter with optical instruments, check table then you can get the Brinell hardness value. Test three times following the same method; calculate the indication error and the repeatability error, which should be in the acceptable range required by ISO6506.2.

Note:

Time duration of test force should be set at 10 seconds when testing hardness block.

8. Calibration of force values

Force values calibration function is available.

Normally force calibration is done by tester manufacturer, which is a very important program for test. Every time when tester is sent back to factory for maintenance, engineers will inspect and calibrate the force values.

8.1 Condition for Starting Force Values Calibration

Normally the function of force value calibration is not authorized to common users. There required condition for the function is as follows:

8.1.1 A qualified mechanics laboratory with certificated mechanics laboratory technicians is a must.

8.1.2 It requires a dynamometer with measuring scope of 200~500kgf, accuracy not lower than 0.2% and in period of validity. The force transducer of the dynamometer should be a strain gauge type (you can purchase it from manufacturer).

8.1.3 Special iron seat is required, which can be purchased from manufacturer or DIY.

8.1.4 Special flat indenter is required, which can be purchased from manufacturer.

If the above conditions are satisfied, you can require the authority from manufacturer to use the function and calibrate the force values by the instructions from technical engineers of manufacturer.

8.2 Ways of Force Values Calibration

Assemble the special flat indenter to tester.

Put force transducer into groove of special iron seat.

Put tester onto iron seat, aiming indenter at pressure point. At the time, indenter is apart from transducer. Turn the magnetic chuck switch to "On", attaching the tester to iron seat.

Turn on the power of tester.

Follow the instruction of manufacturer technical engineer. When arrow points at 10kgf, "10kgf, 60kgf, 150kgf, 200kgf" displays on screen.

Spin hand wheel, and observe displayed force values. When dynamometer shows 10.0kgf, press "Enter" to accomplish calibration of 10kgf. Arrow points at 60kgf at this time. Repeat the steps above, and accomplish the calibration of 60kgf, 150kgf, 200kgf. When these all finish, tester backs to previous menu. Press "Enter" continuously until back to testing status.

9. Misoperation, Faults and Solution

9.1 Misoperation

If misoperation occurred during force loading, it would display “Over load” , “Underload” , “Hold Not Enough” on screen. This test is invalid, and a new test should be taken in another spot.

9.2 Faults and Solution

If it displays apparently wrong test force values, disorder or cannot load the force, it indicates some faults occurred to tester. Press “Reset” to recover tester to state as delivered.

“Reset” operation steps are as follows:

Press “Menu” into functional menu.

Press “△” or “▽” to “Reset” ,press “CONF” continuously until back to test status.

If the operation above does not function, please contact manufacturer to get help.

10. Factors Affecting Test Accuracy

10.1 Surface of part: It will affect test accuracy if the surface of part is rough with oxide skin, decarburized layer, rust and contaminant.

10.2 Operation: It will affect test accuracy if it is not operated skillfully or carefully, or force loading, time duration and force releasing are respective inconformity from beginning to the end among several tests.

10.3 Test force: The deviation of test force in testing will affect result accuracy.

10.4 Test force measuring: After long time using, transducer or electric parts may drift, which may cause test force inaccurate measuring.

10.5 Time duration: When testing the accuracy of the instrument, duration of the test force should be not less than 10 seconds. When testing the work piece, it is permitted to shorten the time duration in order to raise the

efficiency, but the accuracy will be influenced by the short of time duration.

10.6 Hardness block: It will affect test accuracy if block is in following condition: uniformity out of tolerance; bad stability; beyond inspecting valid time; too close distance between indentations; indentation existed in supporting surface; block or iron steel dirty.

10.7 Environment: It will affect test accuracy if temperature changes in a large range; there is big temperature deviation between test and calibration; or there is vibration and dust on site.

11. Parts Introduction

11.1 Adapter

11.1.1 General adapter is delivered with tester. This adapter is fit for flat and cylinder work piece. It should not be disassembled.

11.1.2 If tester could not be attached to irregular parts or attaching force is not big enough, please contact manufacturer which will help to design special adapter and extension indenter. In principle, special adapter and indenter are only for irregular parts in fixed size. For different sizes, there should be allocated by different special adapter and indenter.

11.2 Iron Seat

11.2.1 Iron seat is made of high magnetic permeability material.

11.2.2 The function of it is to test block. Put test block into the groove for test and the groove should be upward.

11.2.3 DO NOT try to test the hardness of iron seat.

11.2.4 It is easy to rust, so keep it dry and clean. Dust on it can enlarge the possibility of measuring error.

11.3 Hardness Block

11.3.1 It is the standard material for calibrating tester. Qualified Brinell hardness block is calibrated by standard hardness tester with its hardness values marked on the edge and signed on the certificate. The standard

hardness tester is traceable to National Standard Hardness Tester through hardness values transfer by block.

11.3.2 The valid time of block is 1 year. Expiry blocks should not be used because its hardness is possible inaccurate. It should be recalibrated by certificate center. Only the front side of it is permitted to use. Block with indentation on back side will cause error in test.

11.3.3 It should keep dry and clean. Rusted blocks will cause relatively big test error.

11.4 Magnetic switch

11.4.1 When not testing, handles of magnetic switch should be always on front horizontal position of “OFF” , if not horizontal, magnetic switch will not close completely.

11.4.2 When testing, put it onto steel parts or iron seat and turn the handles to the back horizontal position of “ON” ,if not horizontal, magnetic switch will not open completely, which causes magnetic force not arriving at maximum values.

11.5 Battery

11.5.1 Common Sense of Battery

11.5.1.1 Please use dry or rechargeable battery required by this tester.

11.5.1.2 Do not drop battery into fire, for possible explosion.

11.5.1.3 Do not disassemble battery, for its electrolyte is corrosive and would hurt eyes or skin.

11.5.1.4 Dry battery is not rechargeable.

11.5.1.5 Keep battery away from conductive materials.

11.5.2 Specification of Battery

11.5.2.1 Power of the tester is supplied from 3 pieces of AA/5# battery, with voltage 1.2–1.5V. It could be alkaline or rechargeable Ni–MH battery.





11.5.2.2 Due to safety restriction of transportation, battery is not in the parts list.

Please purchase it at local.

11.5.3 Electric Quantity of Battery Indicator

Balanced electric quantity of battery will indicates on the right corner of screen as following Table–2:

Table 2

Sybol	Balanced Electric Quantity
	Good
	Medium
	Low(battery should be changed)
Notes: 1. When “  ” displays, finish test within 10mins, change battery. 2. It will consume electric power when standby. The longer standby, the shorter continuous working.	

11.5.4 Exchange Battery

Battery is installed in the battery box on the right side of tester. Take battery box off when exchanging battery.


Hold the edge of battery box and pull it off, then It is disassembled.

Take off used battery and install new ones by the instruction of positive and negative sides.

Push the battery box into tester; keep outside edge of battery box and tester cell in the same surface.

11.5.5 Recharging Battery

Recharge the power off battery in time when using Ni–MH battery.

For new Ni–MH battery, it should be “Recharge and Empty Completely” for 3 times. Recharge it continuously for at least 14 hours and empty the battery when “” displays on screen.

On daily use, try to make the battery work in “Recharge and Empty Completely” .In this way, it would extend the lifetime of battery.

12. Other Instructions

12.1 About work piece to be tested

12.1.1 Materials

The tester is only applied to magnetic iron and steel materials.

It could not be applied to no or weak magnetic high manganese steels, austenitic stainless steels, other austenitic steels or nonferrous metals. Normally for steel materials, the lower carbon content, the better permeability is.

12.1.2 Surface

Surface of parts should be flat and smooth, and the roughness meets at least $6.3 \mu\text{m}$. If the roughness does not meet the requirement, it should be tested more times to decrease the influence to test accuracy.

Polish the oxide layer, decarburized layer, or rust in the surface of work piece rub down and polish the weld joint.

12.1.3 Shapes and Sizes

Parts to be tested could be in any shapes, but there must be a big enough test area, which could be flat or cylinder. The specific requirements are: flat area $> 195\text{mm} \times 60\text{mm}$, thickness $> 6\text{mm}$; cylinder—diameter $> 60\text{mm}$, length $> 200\text{mm}$, thickness $> 8\text{mm}$.

For special shapes, small test area, thin and low permeability parts, they could test by adding special adapter and indenter if there are not so many specifications.

12.2 About Remanence

When magnetic switch is off, there will be a little remanence in tested parts, it will keep tester still attached to the parts. It cannot move the tester by pull the hoop handle.

At the time, do not try to use larger force to pull it, otherwise tester will be damaged. The solution is: horizontally push the tester backward on left or right front side until it slips. Attention: do not push the key parts such as hand

wheel or operation panel.

12.3 About Operation Environment

12.3.1 It should be operated under required environment.

12.3.2 It should be avoid of operating in environment of salt mist, high humidity, high temperature, rain, insolation, dust, vibration, strong magnetic field.

12.3.3 It could not be operated in the temperature of lower than 5°C or higher than 45°C . Try to avoid of operating in the environment in a wide temperature change range.

12.4 Maintenance and Stock

12.4.1 Tester should be stocked in carry case when you do not use it.

12.4.2 The bottom of adapter and iron seat should keep dry and clean, resistance of rust. Paint a little grease on the surface of adapter and iron seat if not operating for a long time.

12.4.3 Do not fall forward the tester, in case of damage to the screen.

12.4.4 If it is predicted not to use for some time, pull out the battery from box in case of contaminating the tester by its weeping

12.4.5 It could not be stocked outdoors for a long time.

12.4.6 Do not use water or detergent to clean it.

12.4.7 Adapter is not permitted to disassemble, except special adapters needed. Other parts are forbidden to disassemble without instruction and authority.

12.5 Transportation

The tester is heavy per unit volume, and it consists of precision machinery and precision electronic circuit, therefore it should be very cautious during transportation. When repaired back to factory, it is very important to pack it in original package. Therefore, the original package should be kept in good condition, including carrying case, vibration-proof materials, and carton box. We are not responsible for the damage in transportation if not packed in original package.

13. Standard Package

- 1 Tester
- 1 Iron Seat
- 12.5mm ball indenter
- 2 Brinell hardness blocks
- 140x reading microscope
- 1 Recharger
- 1 Battery Box
- 1 Carrying case

Optional Accessories

- Ms-1b Brinell Indentation Measuring System

Appendix Brinell hardness table

Ball Diameter D/mm	Test Force F/kgf(N)	Ball Diameter d/mm	Test Force F/kgf(N)
2.5	187.5(1839N)	2.5	187.5(1839N)
Indentation Diameter d/mm	Brinell Hardness (HBW)	Indentation Diameter d/mm	Brinell Hardness (HBW)
0.60	653	1.05	207
0.61	632		
0.62	611	1.06	202
0.63	592	1.07	198
0.64	573	1.08	195
0.65	555	1.09	191
		1.10	187
0.66	538		
0.67	522	1.11	184
0.68	507	1.12	180
0.69	492	1.13	177
0.70	477	1.14	174
		1.15	170
0.71	464		
0.72	451	1.16	167
0.73	438	1.17	164
0.74	426	1.18	161
0.75	415	1.19	158
		1.20	156
0.76	404		
0.77	393	1.21	153
0.78	383	1.22	150
0.79	373	1.23	148
0.80	363	1.24	145
		1.25	143
0.81	354		
0.82	345	1.26	140
0.83	337	1.27	138
0.84	329	1.28	135
0.85	321	1.29	133
		1.30	131
0.86	313		
0.87	306	1.31	129
0.88	298	1.32	127
0.89	292	1.33	125
0.90	285	1.34	123
		1.35	121
0.91	278		
0.92	272	1.36	119
0.93	266	1.37	117
0.94	260	1.38	115
0.95	255	1.39	113
		1.40	111
0.96	249		
0.97	244	1.41	110
0.98	239	1.42	108
0.99	234	1.43	106
1.00	229	1.44	105
		1.45	103
		1.46	101
1.01	224	1.47	99.9
1.02	219	1.48	98.4
1.03	215	1.49	96.9
1.04	211	1.50	95.5