USER'S MANUAL

PHR-300/PHB-300/PHBR-300

AUTOMATIC MAGNETIC ROCKWELL/BRINELL HARDNESS TESTER

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Contents

1. Important Safety Precautions

Before using the instrument, please carefully read and understand all the instructions on safety protection.

1.1 About Hardness Tester Sliding

This hardness tester is mainly made of ferrous material, so it has heavy weight, and accidental sliding may cause personal injury and serious damage to the hardness tester. Therefore, following safety protection measures shall be strictly observed:

1.1.1 When not in use, the hardness tester shall be placed in a flat and stable place to prevent sliding.

1.1.2 When moving the hardness tester, users shall avoid sliding from hands.

1.1.3 When testing curved or inclined workpieces, user should hold the hardness tester firmly, especially when magnetic switch is closed, be careful to prevent the hardness tester from sliding and hurting people.

1.1.4 The iron seat(base) of hardness tester shall also be placed stably to avoid falling and hurting people.

1.1.5 The hardness tester will automatically complete the test process. Do not put your hand under the indenter during test to avoid injury.

1.2 About Strong Magnetic Field

The hardness tester can generate a strong magnetic field when used. When the magnetic switch is turned off, the magnetic field forms a closed circuit inside the hardness tester and does not show magnetism externally. After the magnetic switch is turned on, the magnetic field of the hardness tester is open to the outside, and the hardness tester is equivalent to a strong magnet. At this time, if users are not careful, the hardness tester will suddenly rush into the nearby steel products, which may cause personal injury and damage to the hardness tester. Therefore, the following safety regulations shall be strictly observed during the storage and use of hardness tester:

1.2.1 The hardness tester can be opened only after it is stably placed on the iron seat or steel workpiece. In other cases, the magnetic switch shall be turned off.

1.2.2 During the test, if the magnetic attraction is not enough, the hardness tester may be disconnected from the workpiece. At this time, the magnetic switch should be turned off immediately.

1.2.3 During normal test, the magnetic switch will be easily turned on. When user feels very difficult to turn it on, find out the reason first, and do not forcibly toggle the magnetic switch.

1.3 Battery and Charging

The hardness tester has a charging interface, which can directly charge the internal lithium battery. User should use it according to the user’s manual. Besides, following

provisions shall also be observed:

1.3.1 The charging line and power adapter can only be used based on the specifications required by the instruction manual.

1.3.2 Do not use in an environment with humidity greater than 90%.

1.3.3 It is necessary to ensure the reliability of cable connection during charging.

1.3.4 Prevent water from entering the charging interface.

1.3.5 Pay attention to the positive and negative directions when installing the battery.

2. General Description

PHB (R) – 300 series automatic magnetic Brinell(Rockwell) hardness tester is designed on the basis of PHR–200 digital magnetic Rockwell hardness tester. The instrument adopts an electric force loading system, which can automatically complete the test process in line with relevant standards and realize a more accurate force value control process. The instrument improves the measurement system, applies more advanced sensors and processing circuits, and realizes more accurate force value detection and micro displacement detection.

The instrument applies Rockwell hardness test principle and can test HRC, HRBW and HRA hardness values. The test accuracy meets the regulations of relevant standards ISO 6508 and ASTM E18. The instrument can automatically completes the whole test process and get test results. The test operation is very simple and the efficiency is greatly improved.

The instrument applies Brinell hardness test principle, uses 187.5kg test force and 2.5mm ball indenter to press an accurate Brinell hardness indentation on the workpiece, and uses reading microscope or automatic Brinell indentation measurement system to measure the indentation diameter, so as to obtain accurate Brinell hardness value. The test accuracy meets the regulations of relevant standards ISO 6506 and ASTM E10.

The instrument supports result conversion among different hardness scales.

The instrument has good stability and repeatability, and can realize reliable value transmission. When testing more important workpieces, it can replace the hammer Brinell hardness tester with low precision and the Leeb hardness tester with low precision and reliability.

3.Working Principle and Structure

The hardness tester consists of two magnetic sucking discs and an intelligent hardness test unit. The hardness test unit includes motor, spindle, force sensor, indenter, thread micrometer and encoder for measuring displacement.

During the test, the magnetic sucking disc fixes the instrument on the steel workpiece, the operator starts the automatic test by pressing the key. The force sensor detects the test force on the tip of the indenter in real time, and displays the test force value on the display screen. The depth measuring device composed of precision thread pair and rotary encoder measures the indentation depth. When the test force is removed, the Rockwell hardness value calculated by the microprocessor is displayed on the display screen, and the indenter is automatically raised to an appropriate height.

The Brinell hardness test of this hardness tester only press indentation and does not directly output Brinell hardness value. Additional indentation reading equipment is required.

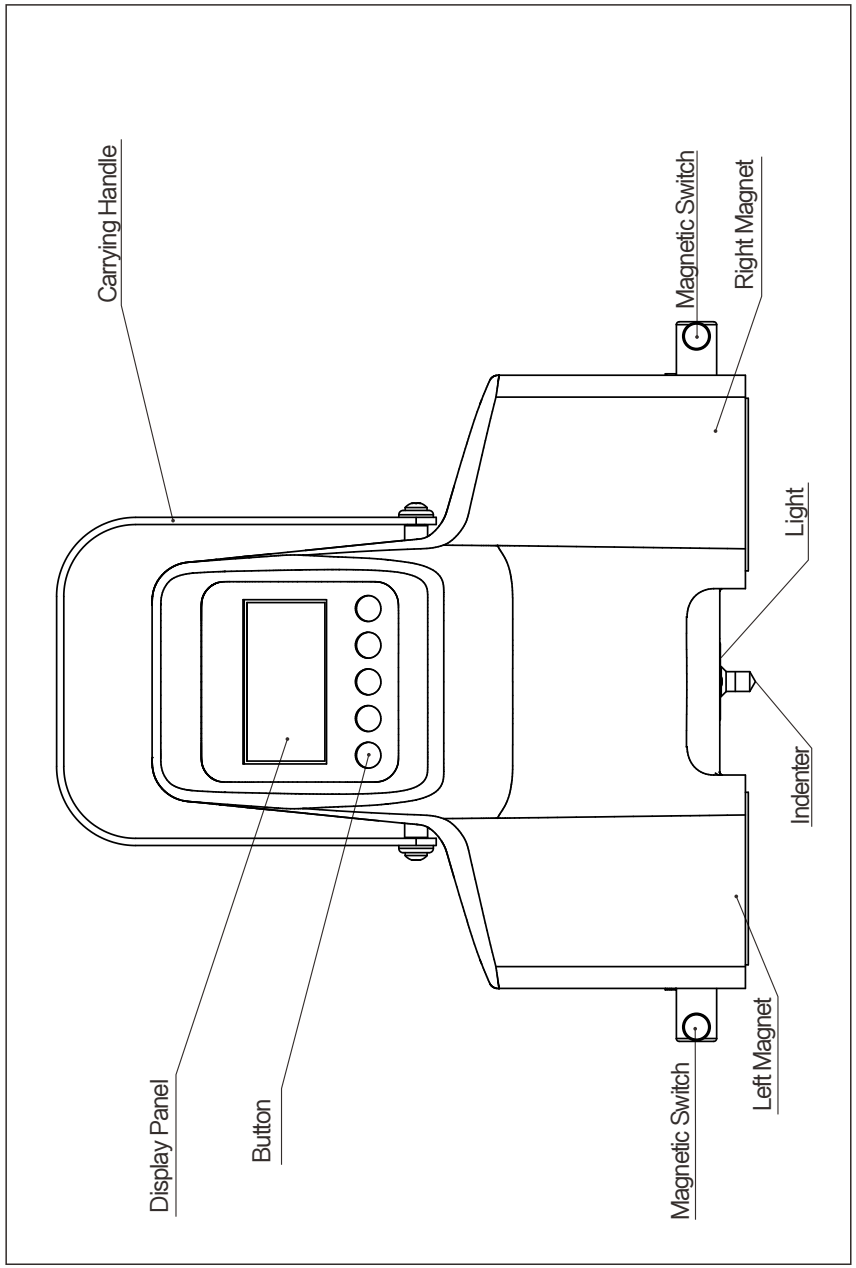

Figure. 1 Front View of the Instrument

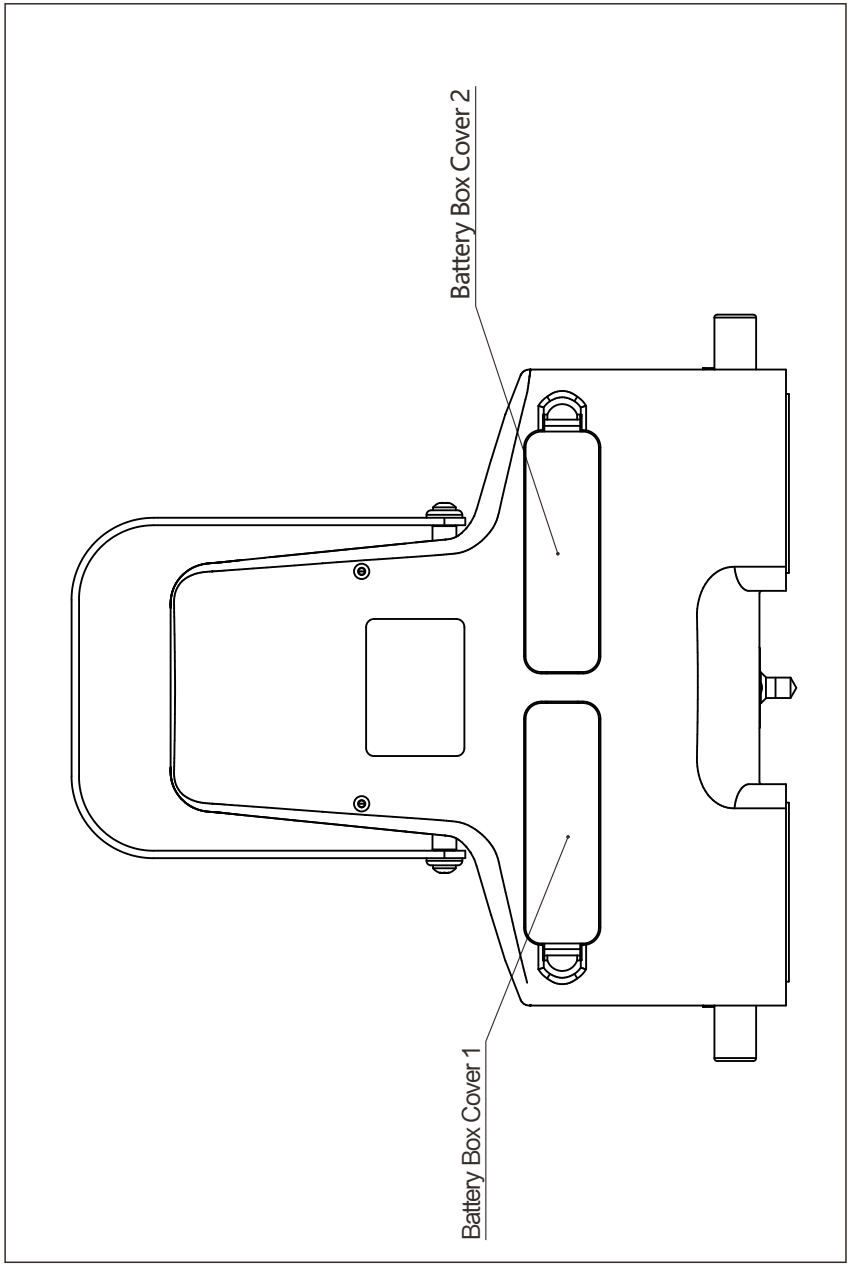

Figure. 2 Back View of the Instrument

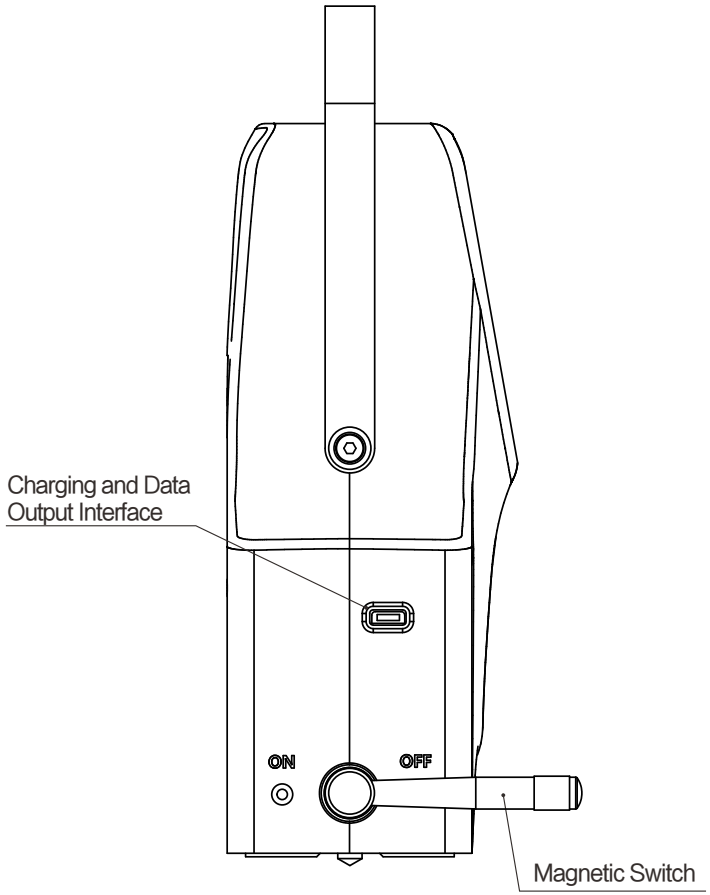

Figure. 3 Side View of the Instrument

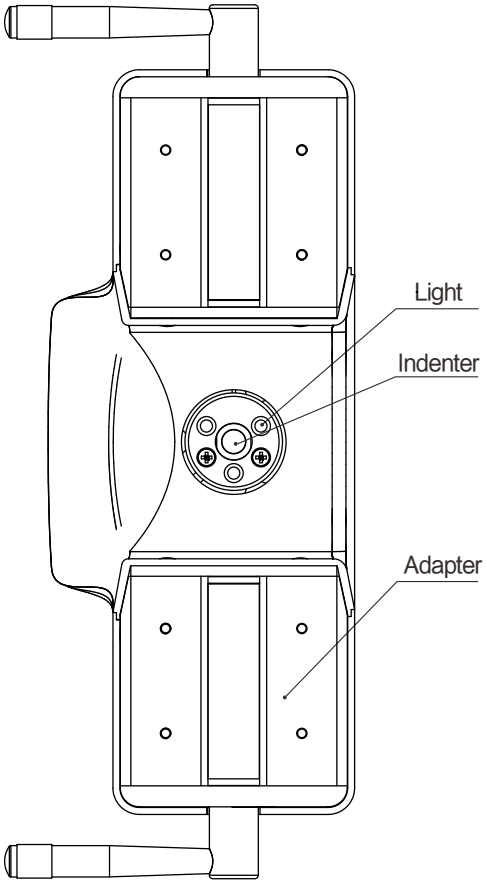

Figure. 4 Bottom View of the Instrument

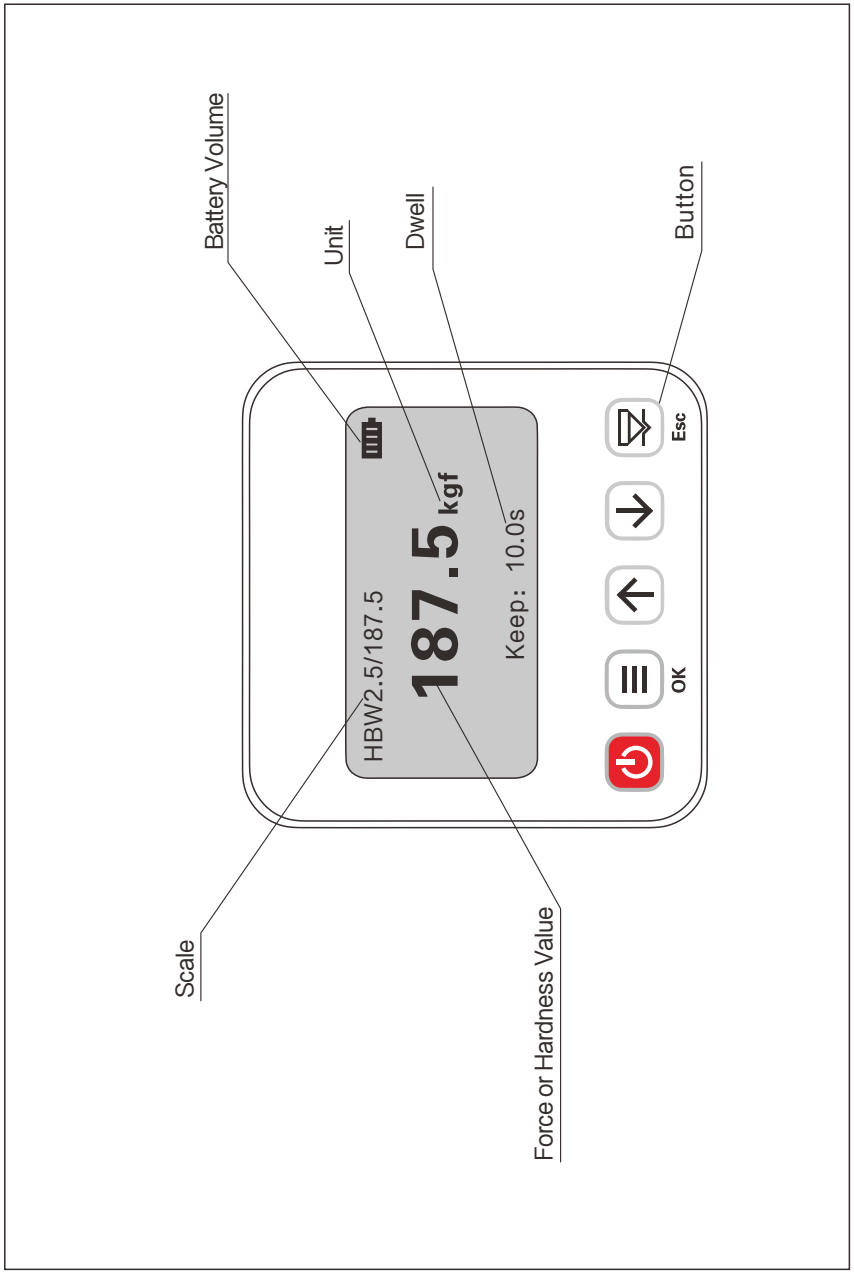

Figure. 5 Keyboard and Screen

4. Button Illustration

Table 1

Button Icon	Button Name	Button Function
	Power Button	Used to turn on and turn off the power.
	Menu Button	Used to call-out option menu, short press will enter test result options page, and pressing for 1.5 seconds will enter the setting options page.
OK	OK Button	Used to confirm operation.
	Up-button	Used to manually raise the indenter; In the options menu, it is used to switch options up or adjust parameters up.
	Down-button	Used to manually move the indenter down; In the options menu, it is used to switch options down or adjust parameters down.
	Measuring Button	Used to start and end automatic measuring process.
Esc	Esc Button	Used to return to the previous page

5. Main Technical Parameters

Table 2

Technical Parameters \ Test Method	Rockwell \ kgf	Brinell optical method
Initial Test Force (kgf)	10kgf	no
Total Test Force (kgf)	60kgf、100kgf、150kgf	187.5kgf
Indenter	120° Diamond Indenter, 1.588mm Carbide Ball Indenter	2.5mm Carbide Ball Indenter
Test Range	20 ~ 95HRA 20 ~ 70HRC 20 ~ 100HRBW	100 ~ 650HBW
Test Resolution	0.1HR	0.005mm
Indication Error	Comply with ISO 6508, ASTM E 18.	Comply with ISO 6506, ASTM E 10.
Repeatability Error	Comply with ISO 6508, ASTM E 18.	Comply with ISO 6506, ASTM E 10.
Working Temperature	5 ~ 45℃	
Weight	5.3kg	
Dimension	Length 250mm * width 97mm * height 245mm	
Minimum Testing Surface	Flat: 195mm*60mm*5mm (Length*Width*Thickness) Cylinder: 60mm*200mm*8mm(Diameter*Length*Thickness)	

6. Using of Hardness Tester

6. 1 Preparation Before Test

Grind the rough measured workpiece to be flat and smooth, and the workpiece shall be free of oxide scale, decarburization layer, pits and dirt.

Note:

User shall check position of hardness tester indenter before test. The indenter tip shall be higher than the bottom plane of the hardness tester, ensure that the indenter will not contact the workpiece after the hardness tester being placed on the measured workpiece, otherwise the indenter will be damaged.

6.2 Adsorption of Hardness Tester

The hardness tester shall be placed on the tested workpiece stably, and the tested surface shall be perpendicular to the axis of the hardness tester indenter. Turn the magnetic switch to "on" to make the hardness tester adsorb on the workpiece.

6.3 On / Off

Press the key to start the instrument, enter the test result page, and maintain the setting state before the last shutdown.

Under power on state, pressing the button again will turn off the instrument, and enter the shutdown page (Figure. 6), turn off the power after 1 second.

If there is no operation, the instrument will shut down automatically after 3 minutes.

If the power is too low, the instrument will execute the over discharge protection program and shut down automatically.

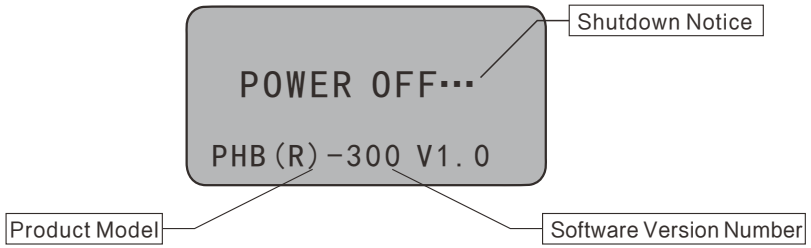

Figure 6. Shutdown page

6. 4 Test Operation

On the test result page (Figure 9), press the "measuring" button Esc to start automatic measurement, and the instrument will automatically complete the test process according to the selected hardness scale. As shown in Figure 8, the page will synchronously refresh the test status, real-time force value, duration and other information.

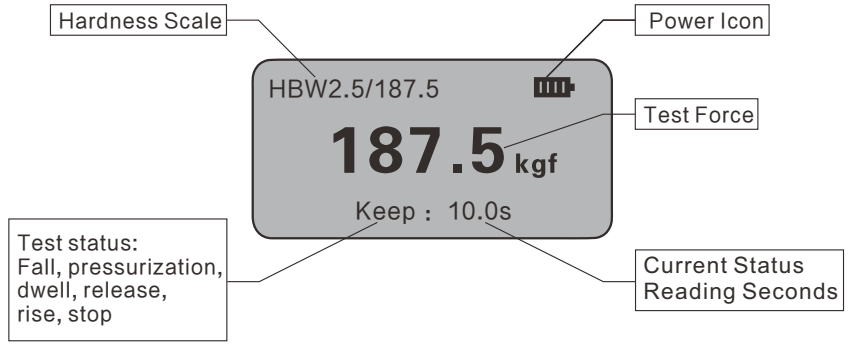

Figure. 8 Test Page

When testing Rockwell hardness, after completing the test process, it will automatically switch to the test result page (Figure. 9), and then the indenter will rise. The page will display the hardness value of the current scale and the hardness value after scale conversion, and determine whether the measurement result is qualified or out of tolerance according to the set acceptable range. When the hardness value is out of test range, the judgment result will prompt invalid.

In the automatic measurement process, pressing any button will terminate the current test and directly enter the test result page. Because the test process is not completed, the result determination will prompt invalid.

When the hardness tester executes the abnormality protection program, it will automatically terminate the test and prompt the abnormality in the judgment result on the test result page.

When testing Brinell hardness, it will not switch to the results page after completing the test process. Read the indentation diameter with a reading microscope, and then check the conversion table to obtain Brinell hardness value. Brinell hardness values can also be obtained directly by using an automatic indentation measurement system.

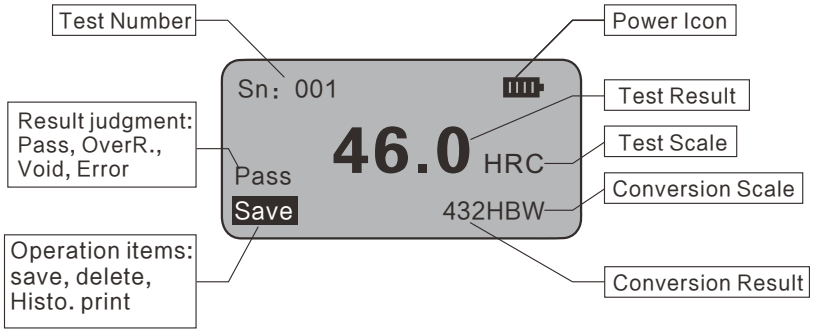

Figure 9 Test Result Page

6. 5 Manage of Test Result

The hardness tester has function of storing test results.

Press "measuring" button (Esc) to start the next measurement. Last valid (qualified or out of tolerance) test results will be automatically saved to the historical data according to the test number.

If it is not necessary to save, press "menu" button (OK) on the test result page to call up the result operation options. As shown in Figure 9, the lower left corner of the page is the operation option. Use "up" and "down" buttons to switch the deletion option, and press "OK" button (OK) to confirm the operation. When the test is started again, the last result will not be saved.

6. 6 Historical Data Query

The hardness tester has function of querying historical data.

In the result operation options under test result page, select query operation to enter the historical data page (Figure 10). User can also find the query option in the setting options and then enter page. Each scale can save 999 sets of test results. When the maximum capacity is exceeded, it will be counted again.

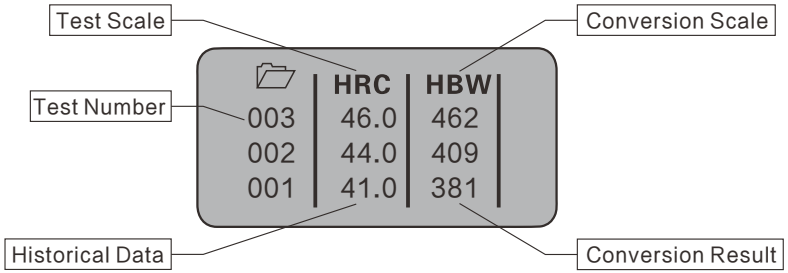

Figure. 10 Historical Data Page

Please kindly note that you can only query the historical data of the current scale. The data includes test number, hardness value of test scale and hardness value of conversion scale. Three groups of data can be displayed on each page. Turn the page with the "up" and "down" buttons, press the "ESC" button (Esc) to exit and return to the test result page.

6.7 Parameter Setting

Long press "menu" button (OK) to enter the setting options page (Figure 11). Move the option icon through "up" and "down" buttons, press "OK" button (OK) to confirm the operation, and then operate "up" and "down" buttons to adjust the current option parameters. Short press can make inching adjustment, press and hold can make continuous adjustment, and the adjustment rate will speed up with the holding time.

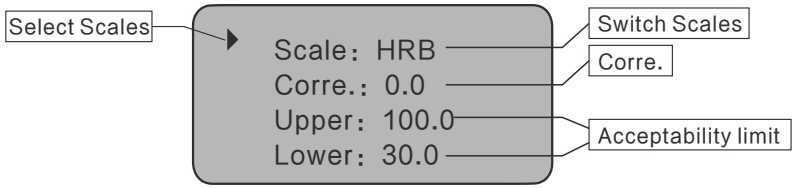

Figure 11

6.8 Scales Selection

The hardness tester can accomplish the measurement of hardness values of multiple scales. The "Scale" options in the settings page(see Figure 11) can switch scales. Rockwell hardness function can use HRC, HRBW, HRA 3 scales; Brinell hardness tester uses 2.5/187.5 scales, press " (OK) " button to confirm the switch. Other settings are synchronized to the settings of the current scale.

6.9 Indicating Value Correction Setup

When testing hardness blocks, if the test results are out of tolerance, the measured values need to be corrected, as shown in figure 11. The calibration value can be adjusted, and the hardness tester will correct the test results according to the set value.

6.10 Acceptability Limit Setup

As shown in figure 11, "Upper" and "Lower" options can set the upper and

lower limits of acceptable hardness range respectively,and the hardness tester will determine whether the test result is qualified according to the set value.

6.11 Select the Conversion Scale

Move the option icon to the bottom edge of the settings page to turn the page. Find the "Conve." option on the second page. You can select the conversion scale or mask the conversion scale.

6.12 Time Duration Setup

Find the "Dwell" option on the second page, hold time can be adjusted.The hardness tester defaults to the best test cycle time (including hold time) within the range specified in the standard and should not be reset in general.

7. Inspection of Hardness Tester

Iron seat (base) and hardness block will be used during hardness tester inspection.

7.1 Acceptable Indication Error and Repeatability Error

Tester complies with standard of ISO and ASTM .The requirements for the accuracy in the regulations please see Table-3.

The accuracy of the Rockwell hardness tester includes two parameters, indication error and repeatability error. The standard stipulates that the difference between the average value of multiple tests on the hardness block and the calibration value of the hardness block shall be within the acceptable indication error, and the difference between the maximum value and the minimum value in multiple tests shall be within the indication repeatability error.

If the hardness tester is out of tolerance, the reason should be found from the test environment first.Try to make each test force loading conditions consistent, using standard hardness blocks and iron seat(base), both should be placed smoothly and enough to fit. The selection of measuring points on the hardness blocks should conform to the standard, and the measuring points should be adjacent and conform to the distance standard. Adopt qualified indenter, and installation is stable and reliable.

Table-3 Acceptable Error of Rockwell Hardness Tester

Scales of Rockwell Hardness	Hardness Range	Acceptable Indication Error	Acceptable Repeatability Error
HRA	20 ~ 75HRA 75 ~ 95HRA	± 2HRA ± 1.5HRA	≤0.02 (100-$\bar{H}^a$) or 0.8HRA[b]
HRBW	20 ~ 45HRBW 45 ~ 80HRBW 80 ~ 100HRBW	± 4HRBW ± 3HRBW ± 2HRBW	≤0.04 (130-$\bar{H}^a$) or 1.2HRBW[b]
HRC	20 ~ 70HRC	± 1.5HRC	≤0.02 (100-$\bar{H}^a$) or 0.8HRC[b]

a: $\bar{H}$ is the average hardness value b: The greater value is valid

7.2 Indication Values Inspection

The indication values should be inspected frequently. A thorough inspection should be taken at regular intervals like 12 months; and a daily inspection should be taken every day 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 the relevant ISO and ASTM standards.

Daily inspection is only conducted for the hardness blocks whose hardness values are closest to the hardness range of the workpiece to be tested. The error should comply with the relevant ISO and ASTM standards.

7. 3 Inspection of Rockwell Hardness Tester (e.g. HRC)

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

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

Check the setting parameters and press the "⏻" button to start the automatic

measurement process and save the effective results. Test 5 points according to the above operation method, query the historical data and calculate the indication error and repeatability error, the errors should comply with the relevant ISO and ASTM standards.

7.4 Inspection of Brinell Hardness Tester

As stated in 7.3, the inspection for Brinell Hardness Block, remove the instrument after get the indentation of Brinell hardness block, 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 the relevant ISO and ASTM standards.

8. Calibration of Hardness Tester

8.1 Calibration of Rockwell Hardness Tester

The instrument can calibrate HRC, HRBW and HRA scale error separately.
When indication hardness value of block is beyond acceptable range, refer to user's manual clause 10 (Faults and Solution) and 11(Factors Affecting Test Accuracy),to search for reasons. When the reason is found, please calibrate as following steps:

- Put the corresponding scale hardness blocks into the iron grooves of the iron seat and carefully test the hardness blocks for 3 times according to the test method described above to obtain 3 valid measurements.
- Adjust the hardness tester measurements according to article 6.8 of this manual.
- Test the hardness block again and compare the test results, and complete the correction if the error is within the specified range.

8.2 Calibration of Brinell Hardness Tester

Brinell hardness test cannot be used to directly correct hardness tester test errors. If the test value is out of tolerance, please find the reason in user's manual clause 10 (Faults and Solution) and 11(Factors Affecting Test Accuracy), also check the indenter, reading microscope, or Brinell Indentation Measuring System. If all is okay, maybe there is something wrong with the hardness tester. Please send back the instrument to manufacturer for inspection.

9. Protection Function

9.1 Low Power Protection

In the upper right corner of the test page(Figure 5),there is a four-cell battery icon is displayed to indicate the remaining battery. When the electric quantity is less than 5%, the reliability of measurement cannot be maintained. At this time, the electric quantity icon shows blank and an exclamation mark(Figure 12) indicates that the program will lock the automatic measurement function and the instrument cannot be used. When the battery charge is less than 2%, there is a risk that the hardness tester will automatically shut down and cannot be restarted. Operators should charge or replace the battery in time.

Power shortage indication

Charging indication

Figure 12

9.2 Charging Protection

The hardness tester supports charging under startup state, and lightning symbol (Figure 12)appears on the battery icon. To ensure the reliability of charging, the program will lock the manual lifting function and automatic measurement function.

9.3 Start Position Protection

When starting, the program will enter the self-check state. If the force value displayed is not zero, the indenter may contact the workpiece. At this time, the hardness tester will automatically execute the indenter reset program, and the hardness tester will automatically lift the indenter, and stop after the test force value disappears and continues to rise 1mm.
When starting the automatic measurement, the program will first detect the indenter force value, if the force value is not zero, then perform the indenter reset program.

9.4 Abnormal Process Protection

In the process of automatic measurement test, the program will monitor the time pressure curve in real time. When the curve trend is abnormal, it will prompt abnormal results on the test results page.
For example, when the main test force is loaded, if the magnetic attraction is insufficient, it will prompt abnormal results on the test results page.

9.5 The Clip Protection

In the process of automatic measurement test, the program will monitor the

displacement force value curve in real time. When the curve trend is abnormal, it indicates that the workpiece is too soft. The hardness tester will automatically lift the indenter and prompt abnormal results.

10. Faults and Solution

10.1 Manual lifting or automatic measurement of the force value in one direction is not moving, the other direction is normal.

First check whether the motor is working, you can judge by the sound. If the motor does not work, check whether the indenter exceeds the limit position.The travel of the indenter of the hardness tester is 6mm. After exceeding the limit position, the program will lock the motor action in one direction. Users should adjust the height of the measured workpiece or replace the appropriate adapter, so that the indenter position of the instrument can be used in the required range.

In the other case, the motor works but the indenter does not move. Consider that the motor is blocked and try to re-operate. If the problem persists, calibrate the indenter position.

10.2 The loading time is too long to reach the specified test force value.

Inspect whether the pressure head is in contact with the tested part.If there is no problem, the actual force value exceeds the motor performance, and the force sensor needs to be re-calibrated.

10.3 Program Error

If the hardness tester display is obviously wrong or garbled, the program is faulty. At this point, you can try to restore the instrument to its initial state by shutting down and then restarting it.

11. Factors Affecting Test Accuracy

11.1 Surface of Workpiece: Workpiece surface roughness, oxide, decarburization layer, rust, dirt, etc., will affect the accuracy of measurement.

11.2 Force Value Deviation: After using the hardness tester for a long time, the sensor or electronic components may drift, and the test force will be out of alignment and the force deviation will affect the measurement accuracy.

11.3 Holding Time: When testing the workpiece, to improve efficiency, it is allowed to modify the holding time, but the holding time is not enough to affect the measurement accuracy.

11.4 Hardness Test Blocks: Uniformity of hardness blocks exceeds error tolerance, the stability is not good, beyond the validity period of verification, the distance between the indentation is too close, the support surface has indentation, the

between the indentation is too close, the support surface has indentation, the hardness blocks or the iron seat(base) is not clean, etc., will affect the measurement accuracy.

11.5 Correction: Hardness value correction deviation, test force correction deviation will affect the accuracy of measurement.

11.6 Environment: The temperature varies widely, the temperature deviation is large between the test and the correction, and the on-site vibration and dust will also affect the measurement accuracy.

11.7 Conversion: Conversion errors will occur when the measured values are converted to other hardness values.

12. Component Description

12.1 The Adapter

12.1.1 The hardness tester comes with a universal adapter that can be used to test flat and cylindrical workpieces. The adapter should not be removed casually.

12.1.2 In case of workpiece with special shape, hardness tester cannot absorb or its suction is insufficient, you can contact TX Testing Company, we can help users to design and manufacture special adapters and special longer indenter. In principle, special adapter and special indenter are only suitable for fixed size special shape workpiece, workpiece of different size should be equipped with different special adapter and special indenter.

12.2 The Iron Seat(Base)

12.2.1 The iron seat(base) of the hardness tester is made of high magnetic conductivity material.

12.2.2 The iron seat(base) is only used for testing hardness blocks or small workpieces. When used, the groove should be upwards, and the hardness blocks or small workpieces should be put into the groove for testing.

12.2.3 Do not attempt to test the hardness of the iron seat(base).

12.2.4 The iron seat(base) is prone to rust and should be kept dry and clean. Dirt on the iron seat(base) may increase the measurement error of the hardness blocks.

12.3 Hardness Block

12.3.1 Hardness blocks are the standard material used for testing and calibration of hardness tester. The qualified hardness blocks have been verified by the standard hardness tester, whose hardness value is marked on the edge of the hardness blocks and the verification certificate. The standard hardness tester shall trace the hardness blocks to the national standard hardness tester through the value transfer.

12.3.2 The validity period of hardness blocks is 1 year. The hardness value of hardness blocks exceeding the validity period may change, so they should not be

used any more and should be sent to a qualified metrology laboratory for re-verification. Hardness blocks are only allowed to be used on the front side. Hardness blocks with indentation on the back will introduce errors during testing.

12.3.3 The hardness blocks should be kept dry and clean. The hardness blocks with serious corrosion will cause large measurement errors.

12.4 Magnetic Switch

12.4.1 When the hardness tester is not tested, the handle of the magnetic switch should always be closed in the horizontal position forward. If it is not in the horizontal position, the magnetic switch will be closed loosely.

12.4.2 During the test, after the hardness tester is placed on the iron and steel workpiece or the iron base, the magnetic switch handle should be moved to the open state in the backward horizontal position. If it is not in the horizontal position, the magnetic switch will not be opened enough and the magnetic suction force will not reach the maximum value.

12.5 The Battery

12.5.1 Battery Knowledge

12.5.1.1 Please use the battery specified in this hardness tester.

12.5.1.2 Do not throw batteries into fire, they may explode.

12.5.1.3 Do not disassemble the battery. The electrolyte released from the battery is corrosive and may damage eyes or skin.

12.5.1.4 Overdischarge may damage the battery. If the battery is not used for a long time, check the remaining power periodically.

12.5.1.5 Do not expose the battery to conductive objects.

12.5.2 Battery Specifications

12.5.2.1 The hardness tester adopts two 18650 lithium batteries for power supply, and the recommended capacity is not less than 3400mAh.

12.5.2.2 Due to transportation safety restrictions, batteries may not be included in the hardness tester shipping list. Users are requested to purchase it locally after receiving it.

12.5.3 Power consumption of hardness tester

Use a group of lithium battery capacity is greater than 3400mAh, can meet the Brinell hardness test more than 300 times, Rockwell hardness test more than 400 times.

12.5.4 Replacing a Battery

The battery is installed in the battery compartment on the back of the hardness tester. When replacing the battery, remove the battery compartment cover.

Note: When installing the battery, check the direction of the positive and negative poles. Otherwise, battery short circuit may occur.

12.5.5 Charging Batteries

There is a Type-c port on the side of the hardness tester to charge the battery inside the instrument. Select the charging line of the corresponding interface and the adapter of 5V1A to connect. The full time does not exceed 4 hours.

You can also take out the battery and charge it with a charger of the corresponding specifications.

13. Other Instructions

13.1 About the Workpiece to be tested

13.1.1 Workpiece material

Magnetic hardness tester can only be used to test magnetic steel materials. Magnetic hardness tester can not be used for non-magnetic or weak magnetic conductivity of high manganese steel, austenitic stainless steel, other austenitic steel and non-iron metals. Generally, the lower the carbon content of steel, the better the magnetic conductivity.

13.1.2 Workpiece surface

The workpiece surface should be flat and smooth, and the surface roughness should reach 6.3μm. If the roughness is not enough, the influence on the measurement accuracy should be reduced by increasing the test times and taking the average value.If there is an oxide layer, decarbonization layer, rust, etc.on the workpiece surface, should be polished off. When testing welds, the welds should be ground and polished.

13.1.3 Workpiece shape and size

The workpiece to be tested may be of any shape, however, it shall have a sufficiently large test surface, which shall be flat or cylindrical. The test surface of the workpiece to be tested should be large enough to meet the following conditions:

Plane surface: area should be greater than 195mmX60mm, thickness should be greater than 5mm. Cylindrical surface: diameter should be greater than 60mm, length should be greater than 200mm, thickness should be greater than 8mm. For the workpiece with special shape, insufficient test area, insufficient thickness and slightly poor permeability, such as narrow strip guide rail, short shaft, short tube, thin shaft, thin tube, ladder shaft, non-cylindrical surface and other special shape of the workpiece, part of the HRA scale can be used by using small test force, After the test, it can be converted to HRC or HRB. Another part of the workpiece, if not many specifications, can be customized special adapter and special indenter solution.

13.2 About Remanence

When the magnetic switch is off, there may be a little residual magnetism on the workpiece to be tested. The effect of this residual magnetism will make the hardness tester still be sucked on the workpiece, and the lifting beam cannot move it. At this point, do not try to lift the hardness tester with more force, or the hardness tester will

be damaged. The proper solution is on the basis of stabilizing the instrument, push the instrument backward horizontally on the left or right side of the front of the hardness tester until the hardness tester slides. Attention: please avoid special parts such as operation panel when pushing the instrument.

13.3 About The Operating Environment

13.3.1 The hardness tester shall be used under the environmental conditions specified in this manual.

13.3.2 The hardness tester should not be used under the environment such as salt spray, humidity, high temperature, rain, exposure, dust, vibration and strong magnetic field.

13.3.3 The hardness tester should not be used in an environment lower than 5℃ and higher than 45℃, and should avoid using in an environment with large temperature changes.

13.4 Maintenance and Storage of Hardness Tester

13.4.1 The hardness tester should be stored in the instrument case when not in use.

13.4.2 Adapter and iron seat(base) on the bottom surface shall be kept dry to prevent rust. When not in use for a long time, the adapter and the iron seat(base) can be coated with a little anti-rust grease.

13.4.3 Do not tip the hardness tester forward to avoid damage to the display.

13.4.4 If the hardness tester is not used for a long time, the battery should be removed to avoid contamination by battery leakage.

13.4.5 The hardness tester shall not be placed outdoors for a long time.

13.4.6 Do not use water or detergent when wiping hardness tester.

13.4.7 Do not remove the adapter unless a dedicated adapter is required. Other parts of the hardness tester shall not be dismantled without authorization.

13.5 About Transportation

The hardness tester weight per unit volume is large, and the manufacture of hardness tester involves precision machinery and precision electronic circuit, the test accuracy of the instrument is guaranteed by the precise coordination of many precision parts, transportation should be especially careful.When the hardness tester is repaired, the use of original packaging is the key to ensure the safety of transportation. Therefore, the original instrument box, shockproof materials and cartons should be well preserved after the instrument is unpacked. If the original packaging is not used, the damage during transportation shall be the responsibility of the user.

14. Assembly

Standard Assembly

Tester
40X Reading Microscope(For Brinell)
Iron Seat(Base)
V Adaptors
120° Diamond Indenter (For Rockwell)
1.588mm Carbide Ball Indenter(For Rockwell)
2.5mm Carbide Ball Indenter(For Brinell)
Rockwell Hardness Block
(For Rockwell HRC high value, HRC low value, HRBW)
Brinell Hardness Block(For Brinell)
Carrying Case

Optional Assembly

Brinell Indentation Measurement System(For Brinell)
Industrial Three-proof Tablet (For Brinell)
Rechargeable Lithium-ion Battery

Appendix Brinell hardness table

Ball Diameter D/mm 2.5	Test Force F/kgf(N) 187.5(1839N)	Ball Diameter d/mm 2.5	Test Force F/kgf(N) 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
1.01	224	1.46	101
1.02	219	1.47	99.9
1.03	215	1.48	98.4
1.04	211	1.49	96.9
		1.50	95.5