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CONCRETE TEST HAMMER PCE-HT 224E

OPERATION MANUAL

CONTENTS

1. Overview

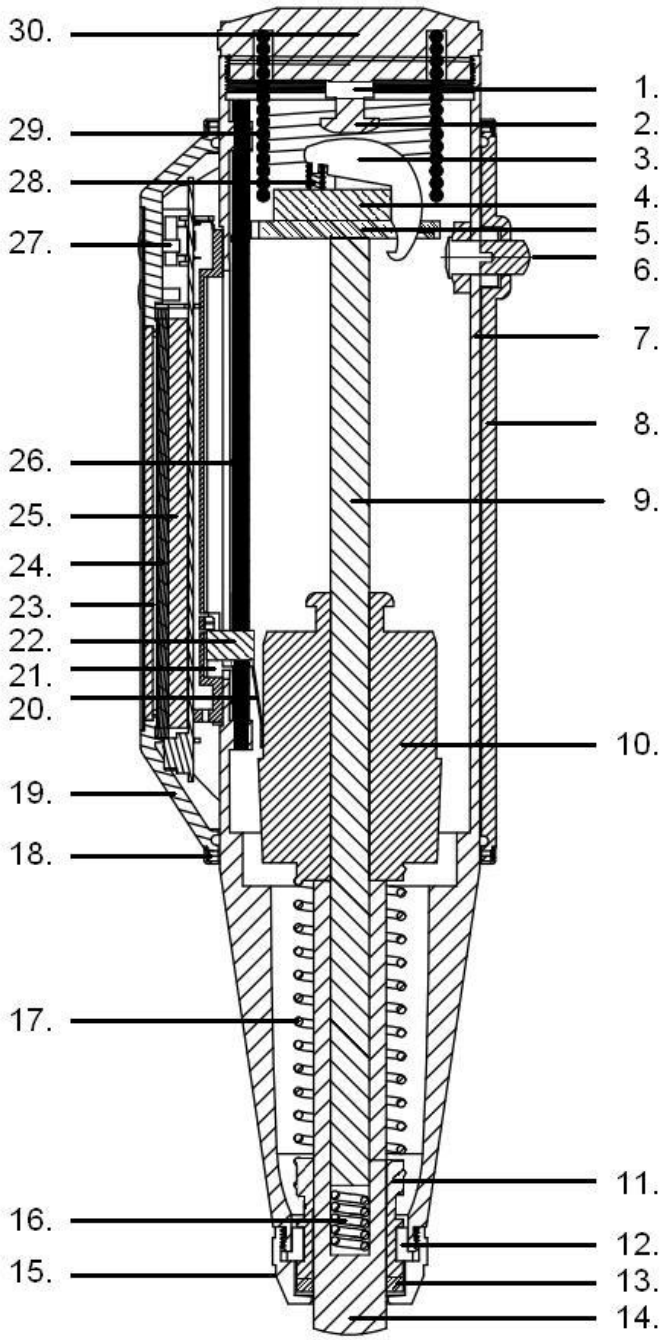
1.1. Brief Introduction to the Device

PCE-HT 224E Digital Rebound Apparatus is a product designed according to *Technical Regulations for Concrete Compressive Strength Test by Rebound Method* (JGJ/T23-2001) (hereinafter referred to as *Regulations*) and developed in order to meet actual requirements for the field test of concrete compressive strength, applicable to the non-destructive testing of common concrete compressive strength in all kinds of construction engineering. It is specifically applicable to the on-site quality sampling inspection by Engineering Quality Supervision Institutions and Supervising Units, for the compressive strength test result of the inspected concrete structure can be got immediately; when the Construction Quality Testing Institution carries out on-site test for real construction objects, it can further reflect the fairness, scientificity and accuracy of the test, greatly improving the working efficiency of testing, data processing and inspection report formation.

PCE-HT 224E Digital Rebound Apparatus has the following characteristics: integrated design, small in size; adopt non-contact optical coupler sense to realize data collection, without changing the original physical structure of mechanical rebound apparatus, in which way the optical coupler sensor has no contact nor friction with the mechanical part of rebound apparatus and thus its service life is extended; inside of the apparatus, national curve and local curve are provided, can be set optionally by yourself; angle, tested surface, pumping or not, carbonization depth and other parameters can be set on site; after detecting data of original value, the original rebound value, testing zone strength value, component overall strength value and other data of the completed component can be checked immediately; self-contained access control further reflects the fairness and safety of the test; equipped with USB data transmission interface, able to transfer data to computer; computer software saves the test data as Excel format, and reporting format can be created immediately, simple and convenient for the later software process; memory space of original data are as much as 1000 components.

1.2. Structure of Concrete Test Hammer

The Concrete Test Hammer is mainly composed of flip system, value-indicating system and shell component. Its structure is shown in Fig. 1. The diagram shows the state that the impact hammer has finished impact in the test and the pushbutton has locked the movement，ie. retaining state of resilience value.



1. Lock nut
2. Trip screw
3. Paw
4. Pin
5. Guide disk
6. Push button
7. Hammer body
8. Housing (downside)
9. Hammer guide bar
10. Hammer mass
11. Guide sleeve
12. Two-part ring
13. Felt washer
14. Impact plunger
15. Cap
16. Retaining spring
17. Impact spring
18. Housing-Aluminum ring
19. Housing (upside)
20. Pointer piece
21. Sensor
22. Pointer block
23. LCD display
24. Circuit
25. Battery
26. Guide rod
27. Buttons
28.Pawl spring
29. Compression spring
30. Rear cover

Structure of Concrete Hammer

1.3. Specification

1.3.1. Mechanical Index of Rebound Apparatus

Metrological verification specifications: *Verification Regulations of Rebound Apparatus* (JJG_817-2011)

Impact energy: 0.225kgm (2.207J±0.100J), for testing ordinary building and bridge construction

Rigidity of recoiling tension spring: 785±30.0N/m

Length of pointer: 20.0±0.2mm

Friction of pointer: 0.65±0.15n

Spherical radius of recoiling rod: R25±1.0

Active length of recoiling tension spring: 61.5±0.3mm

Impact length of recoiling rod: 75.0±0.3 mm

Initial bouncing position of recoiling hammer: graduated scale“0”+1

Calibration value on steel anvil: 80±2

Graduating position “100” of shell calibration: overlap with the side of positioning gap of calibrator cover plate of the rebound apparatus.

Consistency of test indicating value: ≦±1

Operating Temperature: -4ºC-+40ºC

1.3.2. Appliance Indexes

Display screen: high-light blue OLED display screen

Resolution: 256X64

Mass Memory: Maximally can store components: 1000

Maximum number of testing zones:16

Maximum number of test points in a testing zone: 16 times

National unified curve: 1

Customized curve: 2

Battery: can charge high-capacity Li-ion battery

Data interface: Mini-USB interface

Types of sensor: non-contact optical coupler type sensor

Strength unit: Mp, N/mm^2, Kgf/ mm^2

Communication mode: serial port communication, wireless communication (optional)

1.4. Parameter Specification

Test times (test point), for each test point in each testing zone, according to *Regulations*, the test times are 16.

Testing zone, a test unit for testing concrete compressive strength of structure or component, with an appropriate area no more than 0.04 ㎡.

Equivalent value of concrete strength in testing zone refers to the concrete compressive strength value of the tested unit calculated based on the average rebound value and carbonization depth of testing zone via strength-measuring curve.

Test angle, casting surface, if the rebound apparatus is not in horizontal direction or the tested surface is non-concrete casting side, after setting the test angle and casting surface respectively, the apparatus can automatically conduct angular correction and casting surface correction of rebound value.

Carbonization depth: concrete carbonization depth is a kind of chemical corrosion of concrete, and the process reducing concrete alkalinity is called concrete carbonization. Carbonization depth value can be obtained according to the relevant methods of *Regulations*. When input carbonization depth, only have to input a number between 0.0mm and 6.0mm and then the apparatus can, according to the input carbonization depth value, calculate the concrete compressive strength value.

Test of pump concrete strength, set the curve as "national-pumping". According to the *Regulations*, the apparatus calculate the corrected value of pump concrete strength and strength-measuring curve, and the calculated concrete compressive strength value is the strength value of pump concrete.

Strength-measuring curve, the apparatus has four optional curves in total, "national standard-pumping", "national standard-non pumping", "specific curve 1" and "specific curve 2". "National-pumping" curve is a strength-measuring curve formulated according to national unified curve and corrected value of pump concrete strength. When testing the concrete compressive strength, shall choose "national standard-pumping" for strength-measuring curve. "National standard-non pumping" curve is a strength-measuring curve formulated according to national unified curve. For "specific curve 1" and "specific curve 2", Test Unit can formulate specific strength-measuring curve for itself according to the relevant provisions of *Regulations*, which can be used right after being saved in the apparatus via equipped software, and the national standard curve is directly preset in the apparatus.

Strength value displayed by test surface and rebound value at the same time; it is calculated in a different way from that used for the rebound strength value achieved by completing testing zone or structure test. According to the set parameters, rebound value is corrected accordingly, and then the strength result is calculated according to the set curve. The treatment of average value and taking out the max and min value is not conducted, so this strength value is only a reference value.

1.5. Concrete Strength Calculation

1.5.1. Concrete strength calculation under standard measuring mode.

Under standard measuring mode, the parameters setting, strength curve and calculating method of the apparatus all conforms to the relevant provisions of Regulations.

Calculation rules of average rebound value of the testing zone: Each testing zone shall be at least tested 16 times. After 16 times measurements, take 3 maximum values and 3 minimum values out of the 16 rebound values, and get the average value of the remained 10 rebound values. This average value is the average rebound value of testing zone.

Angular correction: when testing concrete casting side in non horizontal direction, angular correction value shall be added to average rebound value. Angular correction value (Appendix 1). For example, average rebound value is 24, test angle is 30 upward, angular correction value is -2.8 and the corrected rebound value shall be 21.2.

Casting surface correction: when testing the concrete casting top surface or bottom surface in horizontal direction, casting surface correction value shall be added to average rebound value. Casting surface correction value (Appendix 2). For example, average rebound value is 24, casting surface is top surface, top surface correction value is +2.1, the corrected rebound value is 26.1.

When testing, if the rebound apparatus is in non horizontal direction, and the tested surface is non concrete casting side, shall conduct angular correction at first and then conduct casting surface correction. For example, average rebound value is 24, test angle is

30 upward, casting surface is top surface. If the angular correction value is -2.8, then the corrected rebound value is 21.2; if the angular correction value is +2.1, then the corrected rebound value is 23.3.

If testing the concrete casting side is in horizontal direction, then angular correction and casting surface correction are not needed. Before the test, test direction and concrete casting surface are set, so the apparatus will correct the average rebound value automatically.

Concrete strength value of testing zone: after testing, it needs to calculate the average rebound value of testing zone and conduct relevant correction. According to user's requirement, it needs to choose "national standard-pumping" or "national standard-non pumping" and then get concrete strength value of testing zone according to carbonization depth value. For example, average rebound value is 24, test angle is 30 upward, casting surface is top surface, carbonization depth is 0.5mm. If angular correction is -2.8 and then the corrected rebound value is 21.2; if top surface correction value is +2.1, the corrected rebound value is 23.3; rebound value 23.3 and 0.5mm carbonization depth corresponds to the concrete strength of 13.4Mp.

Concrete strength value and standard deviation of components: after testing the components, the apparatus shall calculate the concrete strength value and standard deviation of components automatically and save them, according to the relevant formulas of *Regulations*.

1.5.2. Calculation of concrete strength under customized measuring mode.

When user's preset parameter does not confirm to Regulations, that is, customized measuring mode, such as the test times are less than 16.

Calculation of average rebound value of testing zones. After the testing, maximum and minimum values are not taken out, only conduct the average calculation.

For angular correction, casting surface correction, the setting, calculation, standard measuring mode and correction method of these two parameters are the same.

Concrete strength value of testing zone: after testing, it needs to calculate the average rebound value of testing zone and conduct relevant correction, if the user chooses "national standard-pumping" or "national standard-non pumping", it can get concrete strength value of testing zone according to carbonization depth value. This concrete strength value can only be used as a reference value, because it does not conform to the relevant provisions of *Regulations*. If the user has already formulated its own specific curve, and set the apparatus strength-measuring curve as this specific curve, the apparatus will refer to the table to get the concrete strength formulated by user itself.

Concrete strength value and standard deviation of components: after testing the components, the apparatus will average the contained concrete strength value of testing zone and get the concrete strength of component, and calculate the standard deviation automatically according to the relevant formulas.

If the parameters, calculating method and apparatus used by the user are different from the set ones, the original rebound value can be transmitted to computer taking components as unit via the equipped upper computer software.

1.6. Operation Procedure

1.6.1. Start to test new components

After startup, press confirm key to enter main interface, choose “test mode” and enter, then choose “test a new component” interface, after entering, the test of a new component is started, and you cannot return to top level menu at this moment. The default standard parameters setting: component name GJXXX, test times 16, number of testing zones 16, national standard-non pumping (national unified curve GB/T23-2001), horizontal zero degree, side, carbonization depth 0.0mm are users’ frequently-used setting options, as the default standard setting convenient for test personnel to use. After the setting is completed, choose “ok” to enter test interface， thus the test starts. The apparatus will save the parameters and current test condition of the setting automatically; If restart the computer after turning it off, the unfinished test before turning off the computer can be continued.
During the test process, if some parameters shall be corrected. Press confirm key to enter main interface, and choose “test mode”, and then choose “testing zone set” interface. On this interface, test angle, casting surface and strength-measuring curve can be modified. After modification, choose “ok” to exit, and the apparatus will save the corrected content automatically.

1.6.2. Testing zone is completed.

If the recoiling times reach the set test times, the testing zone test is completed. Apparatus prompts: “testing zone is completed” and it will enter the next testing zone after a 3-second stop.

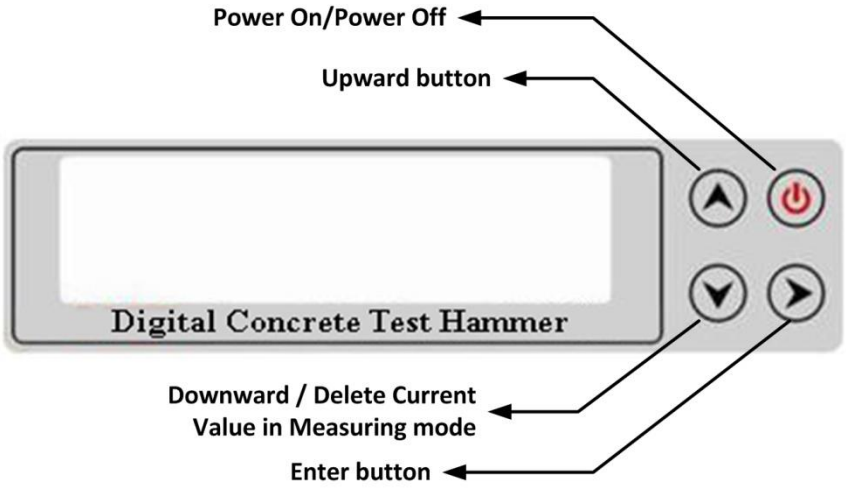
1.6.3. Test part is completed

When finishing the setting of the last testing zone, the test part is completed. Then the apparatus enters test part completion interface. In this interface, users can choose to: check the testing zone result, check test part result, measure new test part and measure the current testing zone again.

1.7. Calibration Test

Calibration test is a test, according to the relevant provisions of verification and rebound apparatus calibration experiment in *Regulations*, in order to test the correction of testing result of rebound apparatus. According to *Regulations*, the calibration value of rebound apparatus shall be kept between 80±2, and specific calibration interface is set in the apparatus, convenient for users to conduct routine calibration verification before carrying out the test. After entering the interface, according to the relevant provisions of rebound apparatus calibration experiment, conduct 4 groups of recoiling test (4 times for each group). After the test, press confirm key to exit.

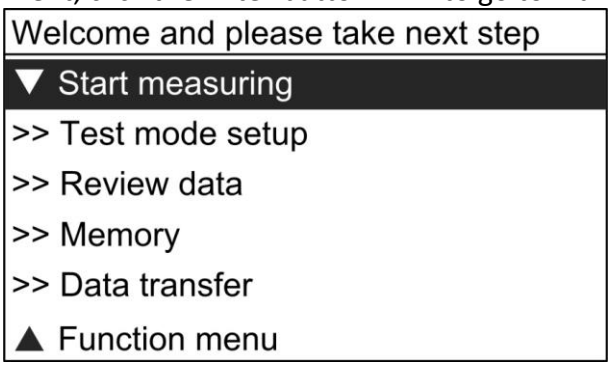
2. Button Description



3. Measuring

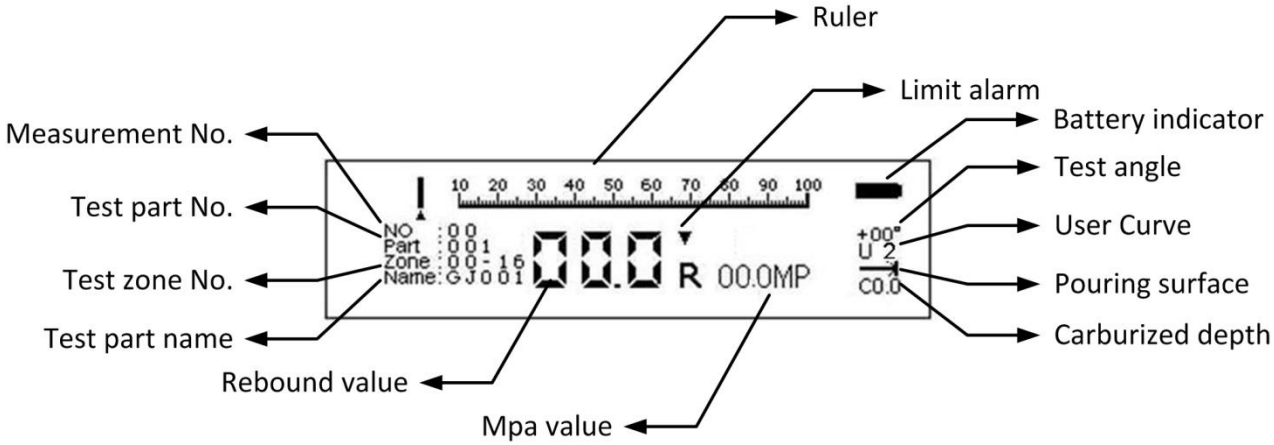
Turn on the instrument, and go to the measuring interface. If no parameter setting is needed, simple measurement can be done.

Turn on the instrument; click the Enter button to go to main menu.



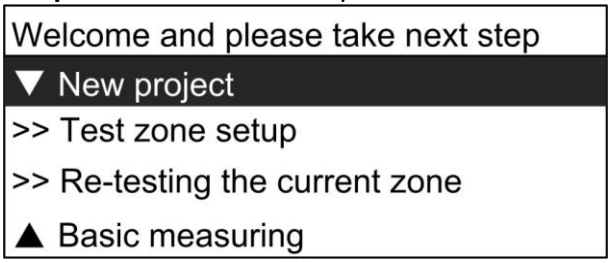
3.1. Start measuring

Select ***Start measuring*** from the menu and press to enter measuring mode. In this mode, you can take measurement.



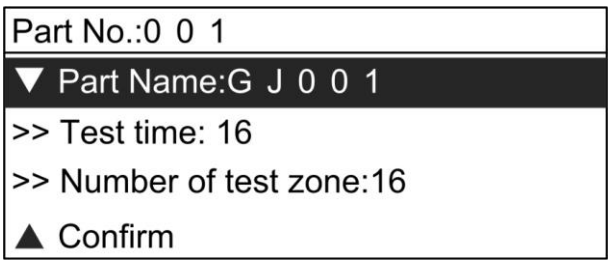
3.2. Test mode setup

Select ***Test mode setup*** from the menu and press to enter test mode setup interface.



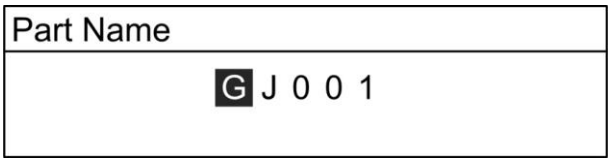
3.2.1. New project

Select ***New project*** and press to enter New project interface, it will create a new part.
The default setting for the new part is as below:
Part name is GJXXX, like GJ001
Number of test time is 16
Number of test zone is 16



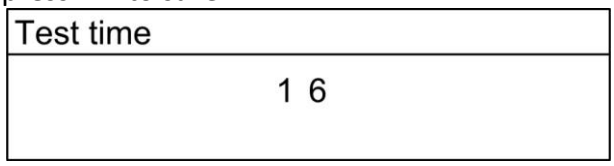
3.2.1.1. Setting part's name

In the parameter setting interface of new part, use the up and down arrows to select PART NAME, and press Enter button to begin to set the name. Adjust the value of each digit of the name with Upward button (each digit has 36 alternatives, namely 0-9 and A -Z). Press Downward button to move to the next digit, and so on, until the last digit is adjusted. Click the Enter button, the part name will be saved and return to the parameter interface of test part.



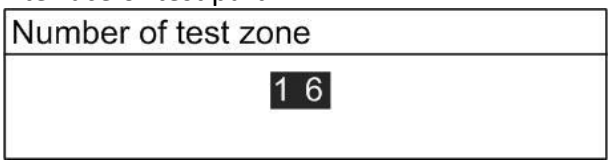
3.2.1.2. Setting the number of test time

In the interface of new part, use upward and downward buttons to select Test time, and press Enter button to enter setting interface. Press and to adjust the number of test times (1-16), press to save.



3.2.1.3. Setting the number of test zone

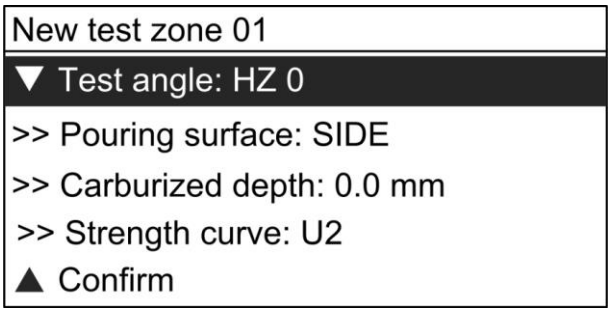
In the parameter setting interface of new part, use upward and downward buttons to select the number of testing zone, and then press Enter button to set the number of testing zone. Press and to adjust the number of testing zones (1-16), press to save and return to the parameter interface of test part.



After finishing test part setting, select Confirm and press Enter button to move to test zone setting.

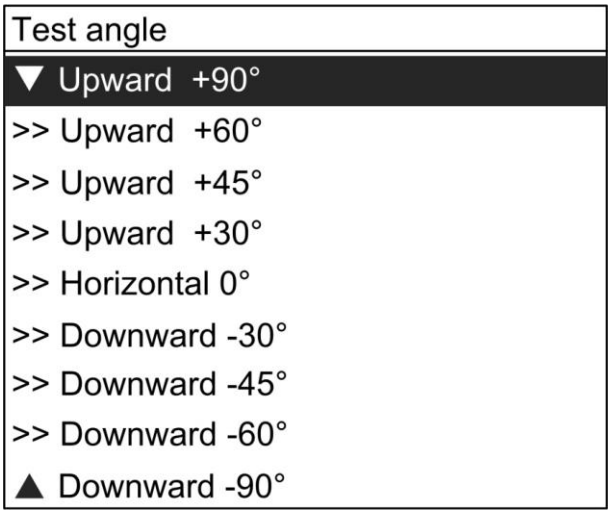
3.2.2. Test zone setup

There are four parameters for test zone: test angle, pouring surface, carburized depth and strength curve.



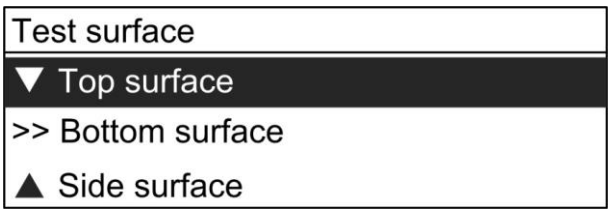
3.2.2.1. Setting test angle

On the parameter interface of new test zone, use upward and downward buttons to select test angle, and then press Enter button to set test angle. There are a total of 9 angles available. Press and to select, then press to save and return to the parameter interface of test zone.



3.2.2.2. Setting poured surfaces

On the parameter interface of new test zone, use upward and downward buttons to select pouring surface, and click Enter button to set pouring surface. There are a total of 3 surfaces available (Top surface, Bottom surface and Side surface). Press and to select, then press to save and return to the parameter interface of test zone.



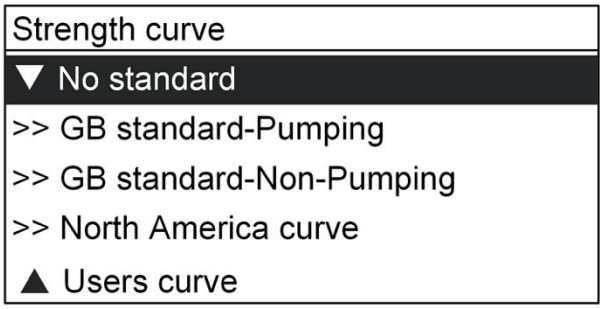
3.2.2.3. Setting carburized depth

In the parameter setting interface of test part, use upward and downward buttons to select the carburized depth, and then press Enter button to set carburized depth. Press and to adjust carburized depth from 0.0-6.0 (13 alternatives, 0.0mm, 0.5mm, 1.0mm, 1.5mm, 2.0mm, 2.5mm, 3.0mm, 3.5mm, 4.0mm, 4.5mm, 5.0mm, 5.5mm and 6.0mm).

Press  to save and return to the parameter interface of test part. After selection, the default carburized depth of each test zone is the same as that of this test part. The carburized depth of each test zone can be modified in the parameter setting of test zone.

3.2.2.4. Setting strength curve

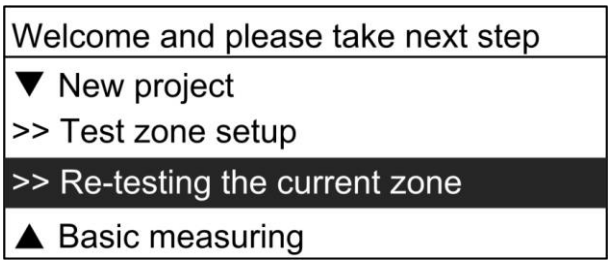
On the parameter setting interface of new part, use upward and downward buttons to select strength curves, and then press Enter button to set strength curves. The default curve is the national standard curve. Press and to select, then press to save and return to the parameter interface of test part.



After finishing test part setting, select Confirm and press Enter button to return to measuring mode.

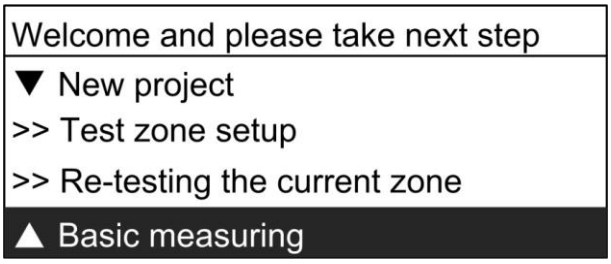
3.2.3. Re-testing the current zone

Press to enter main menu, select ***Test mode setup*** and press to enter test mode setup interface. Select ***Re-testing the current zone*** and press to re-test the current zone. The test no. will return to 0.

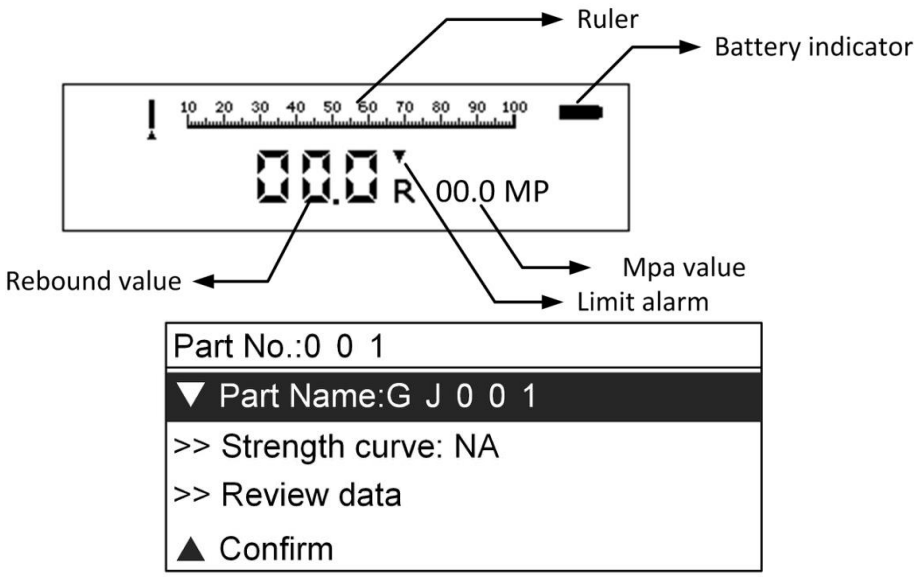


3.2.4. Basic Measuring

Press to enter main menu, select ***Test mode setup*** and press to enter test mode setup interface. Select ***Basic measuring*** and press to enter basic measuring mode.

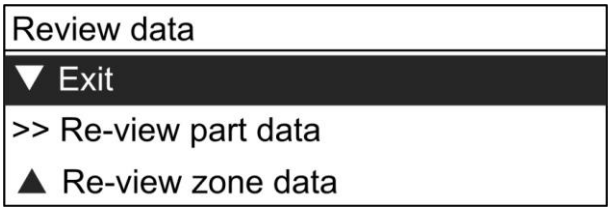


In this mode, only Ruler, Rebound value, MPa value, Limit alarm and Battery indicator will be displayed on LCD. A new part will be created in this mode, it can store 100 x rebounder data and 100 x strength data, all data could be reviewed. When the storage is full for this part, a new part will be created automatically.

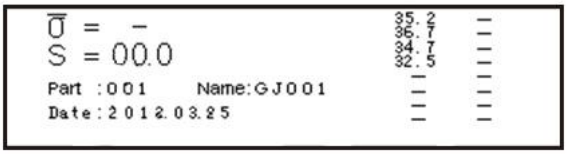


3.3. Review data

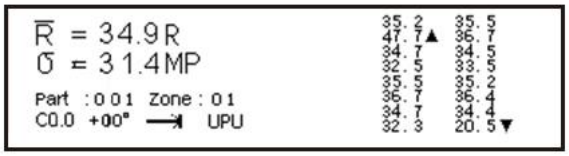
Click Enter button to go to main menu. Then select Review data and click Enter button to enter the Review data menu.



1) Exit from current menu and enter measuring interface.
2) Re-view part data: review the results of completed test parts.



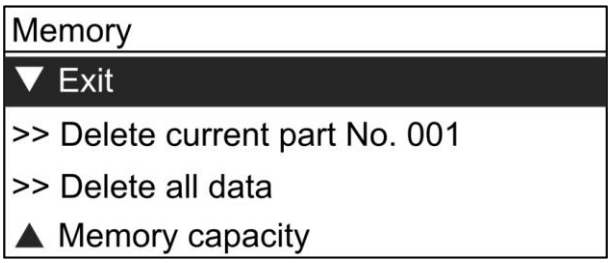
3) Re-view zone data: review the results of completed test zones.



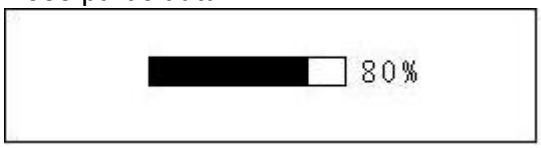
Enter Re-view zone data, the data of last test zone of current test part will be displayed on LCD. Press or to page up or page down; press to exit.

3.4. Memory

Click Enter button to go to main menu. Then select Memory and click Enter button to enter Memory menu.

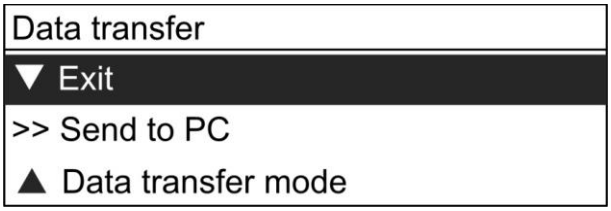


1) Exit from current menu and enter measuring interface.
2) Delete current part: clear data for current part.
3) Delete all data: clear all measured data.
4) Memory capacity: Show the percentage of memory capacity (0~100%), the memory capacity is up to 1000 part's data.

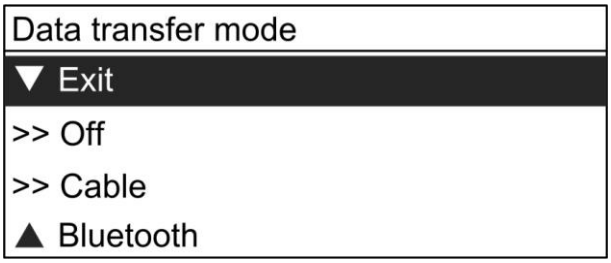


3.5. Data transfer

Click Enter button to go to main menu. Then select Data transfer and click Enter to enter Data transfer menu.



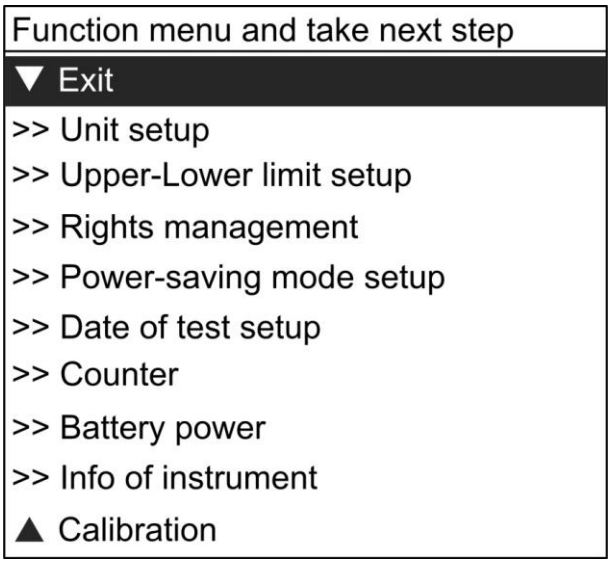
Before creating communication between instrument and PC, use USB cable to connect PC and the instrument, then enter Data transfer menu to select Data transfer mode. Cable for USB connection, Bluetooth for Bluetooth wireless connection (option). Off to disable Bluetooth connection.



Then select Send to PC, "Transfering" will be displayed on LCD, which means the instrument is in communication mode.

Regarding the operation of PC software, please refer to Chapter 5.

3.6. Function menu

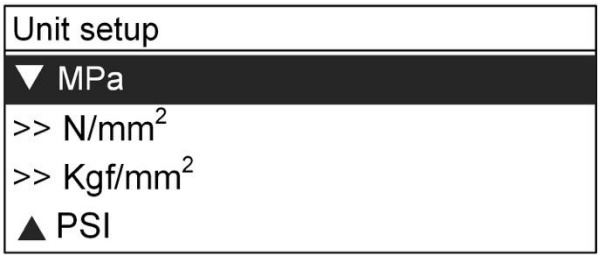


3.6.1. Exit

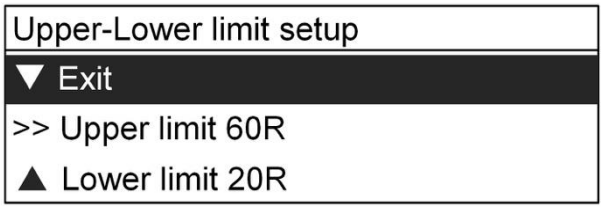
Exit from current menu and enter measuring interface.

3.6.2. Unit setup

Select different units.

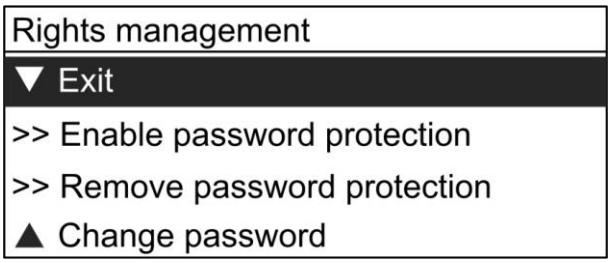


3.6.3. Upper-Lower limit setup



Set up upper/lower limit of rebound value (00~60). Press ⓐ and ⓑ to change the number, then press ⓒ to save.

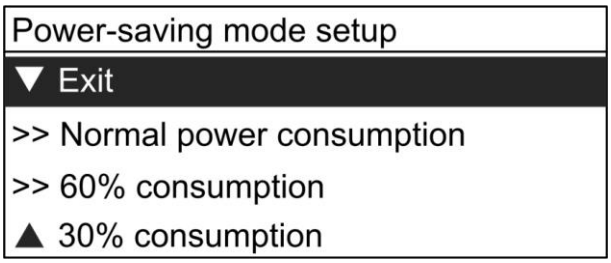
3.6.4. Rights management



In this menu, user can enable, disable and change password for this instrument. After enable and set password, the password needs to be input for Re-view data, Upper-Lower limit setup and rights management.

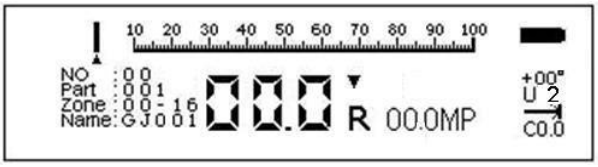
Press  to move cursor to next number, press  to change current number from 0 to 9.

3.6.5. Power-saving mode setup



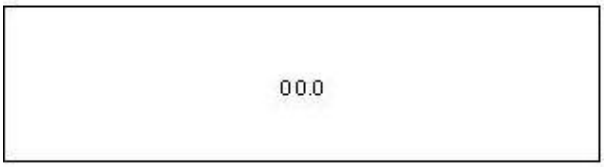
In this menu, there are 3 kinds of power consumption modes for choosing.

Measuring interface in normal power consumption, in this mode, the instrument could work 8-10 hours after fully charging.



Measuring interface in 60% power consumption, in this mode, the instrument could work 10-13 hours after fully charging.

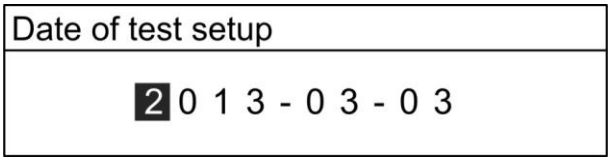
Measuring interface in 30% power consumption, in this mode, the instrument could work 13-16 hours after fully charging.



In power-saving measuring modes, press ⊙ to switch to normal measuring interface, press ⊙ again and then select Start measuring to return to pre-defined power-saving measuring interface.

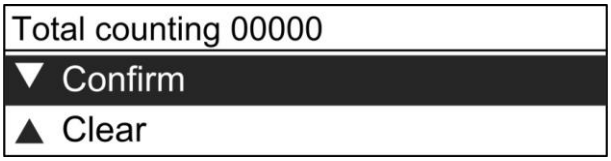
3.6.6. Date of test setup

Select Date of test setup to enter date setup interface. Press ⊙ to move cursor and press ⊙ to change number.



3.6.7. Counter

Select Counter and click ⊙ to go to the counter to see the number of tests. The number of tests can also be cleared.



3.6.8. Battery power

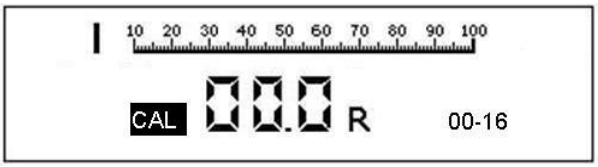
Show the percentage of battery capacity (0~100%).

3.6.9. Info of instrument

Show basic information of the tester. (Serial number and firmware version)

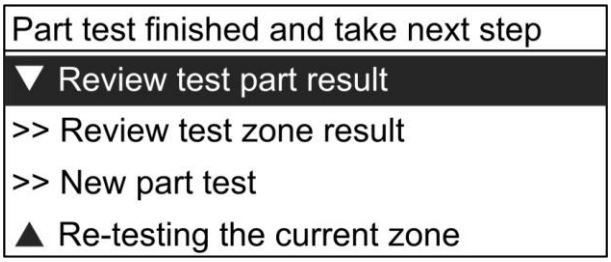
3.6.10. Calibration

After maintenance, user can calibrate this instrument. In calibration mode, do 16 times test on calibration anvil, then press ➤ to finish calibration and exit this interface.

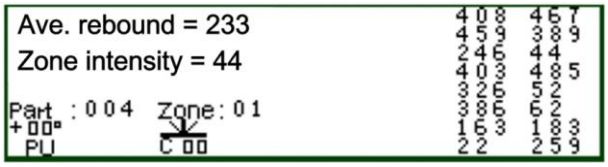


3.7. Completion of test zone and test part

After finishing measurements of one test zone, it will enter to next test zone automatically. After all test zones have been measured, go to the completion interface of test part, and the measurement for the current test part is completed. The completion interface of test part contains Review test part result; Review test zone result, New part test, Re-testing the current zone and Function menu.



On the interface for Review test zone result, measurements of this test zone are displayed on the right, and paramter symbols of this test zone are displayed on the lower left.



Review test zone result

On the interface for Review test part result, strenghts of each test zone are displayed on the right, and the name and number of this test part are displayed on the lower left.

Interface for Review test part result

4. Maintenance

For rebound apparatus, when one of the following situations occurs, routine maintenance shall be conducted:

- Recoiling is over 2000 times
- Be skeptical about the test value
- Constant value of steel anvil rate is unqualified

Common maintenance methods shall fulfill the following requirements

- After getting the recoiling hammer off, get out the internal machine, and remove recoiling rod (get out the inside buffer spring) and triple unit (including recoiling hammer, recoiling tension spring and tension spring base)
- Clean all components and parts of the internal machine with gas, especially for central guide rod, inner bore and shock surface of recoiling hammer and recoiling rod. After cleaning the central guide rod, wipe it with a thin layer of watch oil, while other components and parts shall not be wiped with oil.
- Clean the internal wall of shelf, remove graduated scale, and the frictional force of inspection pointer shall be 0.5-0.8N
- Can not rotate the zero setting screw fixed on tail hood
- Self-made or changing components and parts are not allowed
- After maintenance, calibration test shall be conducted according to the requirements, and the calibration value shall be 80±2

5. Introduction of PC software

Thedata communication software is designed for reading and processing the data of test part of the concrete test hammer. It can read the data of measured test part from the digital concrete test hammer, store the data in the computer, generate a report for the data of test part and print the report.

System requirement: A PC with USB port
Windows XP, Windows 7, Windows 8, NetFramework 2.0

5.1. Connect PC and hammer

Before using PC software, please do the following steps to start communication between PC and hammer.

1. Connect PC and hammer using USB cable supplied with new instrument.

2. Power on the concrete test hammer, press  to enter main menu, then select Data transfer →Data transfer mode→Cable

3. Select Data transfer → Send to PC, “Transferring” will be displayed on LCD and transmission is started.

5.2. Driver installation

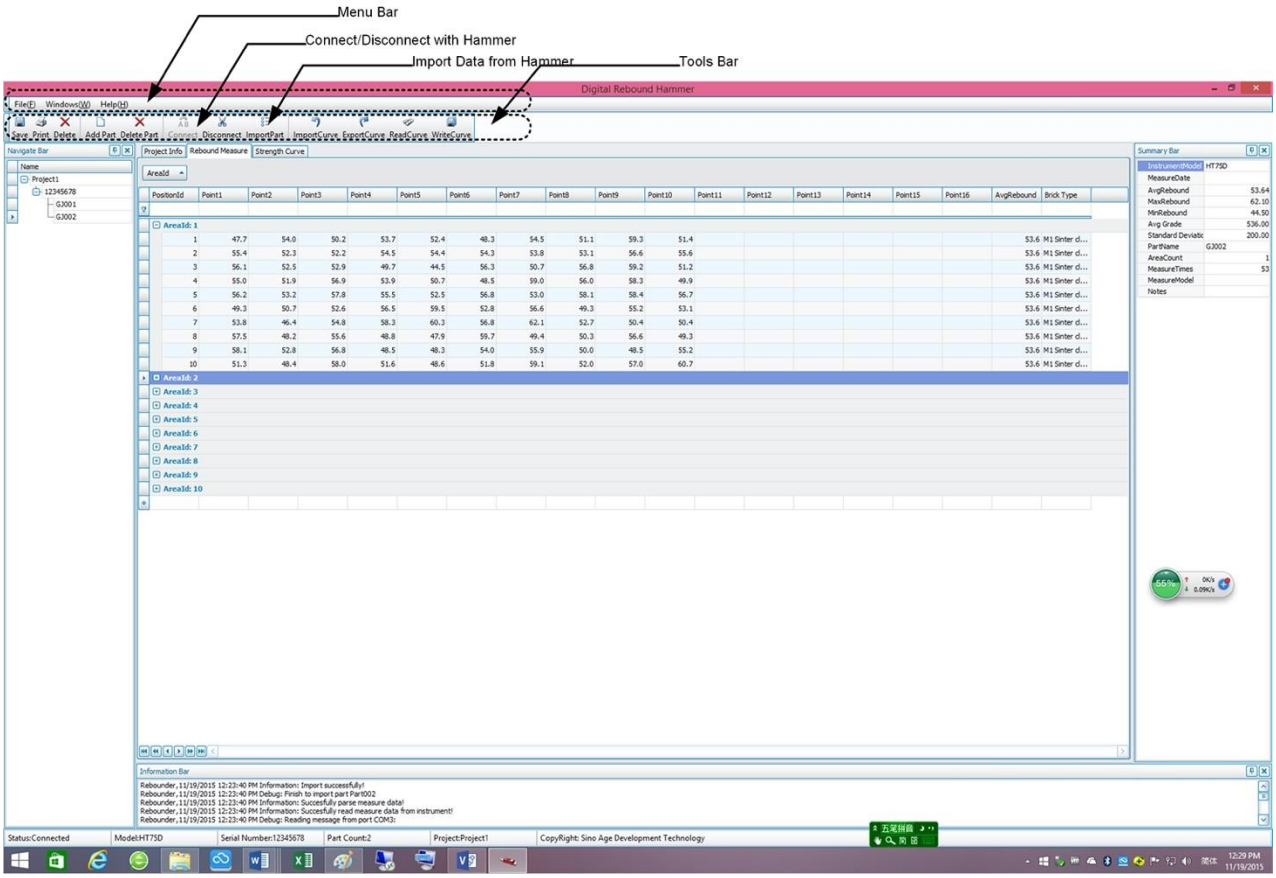
Computer will prompt "Found new hardware" while the digital hammer is connected to the computer first time, please install the driver located in X:\Drivers folder. (X: means CDROM drive letter).

5.3. Software Installation

Install "Digital Rebound Hammer" software
Double click "Setup\setup.exe"

5.4. Start PC software

After data communication software is installed, a shortcut will be created on the desktop automatically. Double click the shortcut to run the program.



The main interface of the software is a standard windows form, containing the title bar, menu bar and toolbar.

Please note: After running the software, click the "Connect" from the toolbar to create connection between PC and hammer.

Appendix 1- Common Mechanical Failures and Maintenance Methods of Apparatus

When the apparatus conducts recoiling test, if the display number does not change or the rebound value has deviation, this condition is usually caused by mechanical failure. The solutions for common mechanical failures of rebound apparatus are listed in the following table:

No.	Failure Condition	Cause Analysis	Maintenance Methods
I	During rebound apparatus test, pointer block 22 stops at the initial place without moving.	1. Compared with pointer piece 20 of pointer block 22, the field angle of guide rod 26 is too small.	Remove pointer block 22, and enlarge the field angle of pointer piece 20 appropriately
		2. Pointer piece 20 is broken.	Remove pointer block 22 and change pointer piece 20
II	Pointer block 22 is brought up before recoiling, and can not indicate the rebound value normally.	1. The field angle of pointer piece 20 on pointer block 22 is too big.	Remove pointer block 22 and wrench the field angle of pointer piece 20 smaller appropriately
		2. Tightness between pointer block 22 and guide rod 26 is too loose.	Remove pointer block 22, adjust the friction between pointer block 22 and guide rod 26 (0.65±0.15n)
III	During recoiling process, pointer block 22 shakes, moves up to a certain place and stops there.	pointer block 22 rubs or bumps spring back hammer body 7	File the upper surface or two shoulders of pointer block 22 appropriately with a mall file
IV	Recoiling hammer mass 10 launches too early.	1. The end of paw 3 becomes small obtuse angle.	File the end of paw 3 to right angle with a file;
		2. Part of the end of recoiling hammer mass 10 is broken.	Turn the recoiling hammer mass 10 to a certain angle or change it.
V	Rebound apparatus can not rebound and recoiling hammer mass 10 can not move up.	1. The paw spring 28 of paw 3 falls off and does not work;	Install paw spring 28, or adjust its elastic force and operating position well.
		2. The end of paw 3 is broken.	Change paw 3；
		3. The end of paw 3 wears from an accurate angle to a big obtuse angle.	File the paw end of paw 3 to right angle.
VI	Recoiling hammer mass 10 is reluctant to launch or can not launch.	1. The bulge part of the end of paw 3 touches the surface of recoiling hammer mass 10	File the bulge part of the end of paw 3 about 1mm upwards;
		2. The end of paw 3 is acute angle	File the end of paw 3 to right angle.
VII	Impact plunger 14 can not be extended, can not be used.	Push button 6 is loose, the small spring inside does not work.	Hold and press the tail hood and twist it 30 times, to make guiding flange move downwards, and adjust the button spring well and screw up push button 6.

VIII	Rebound value is relatively high.	1.Active length of impact spring 17 is longer than 61.5mm	Adjust the fixed position of impact spring 17 on guide sleeve 11
		2. The launching position of hammer mass 10 is relatively high, (impact spring17 extends too long).	Twist the adjusting bolt of tail hood 30 outwardly
		3. Hammer guide bar 9 is wiped with too much oil.	Remove recoiling component elements and clean it with cotton yarn
IX	Rebound value is relatively low.	1. The active length of impact spring 17 is less than 61.5mm;	Adjust the fixed position of impact spring 17 on guide sleeve 11
		2. The launching position of hammer mass 10 is low;	Screw the adjusting bolt of tail hood 30 inwardly
		3. The friction of pointer block 22 is relatively high;	Adjust the coordinate tightness degree between pointer block 22 and pointer axis 26, and make then friction between 0.65±0.15N
		4. The shock surface of recoiling hammer mass 10 is dirty;	Clean the dirt on casting surface
		5. The friction between recoiling hammer mass 10 and central guide rod increases.	Wipe the hammer guide bar 9 with appropriate amount of watch oil or sewing machine oil.
X	Rebound value is unstable, sometimes high and sometimes low	1. The shock surface between recoiling hammer mass 10 and Impact plunger 14 contacts unevenly	Turn Impact plunger 14, or change Impact plunger 14
		2. Shock surface or central guide rod 9 is dirty	Clean dirt
		3. Hammer guide bar 9 is not straight	Align hammer guide bar 9
		4. The friction between pointer block 22 and guide rod 26 is uneven	Adjust the friction between pointer sliding block 22 and guide rod 26
		5. Bad contact between pointer piece 20 and hammer mass10	Adjust the size of field angle of pointer piece 20 appropriately
		6. Pointer block 22 rubs or bumps hammer body 7 on the groove.	File and repair flat surface or shoulder surface of pointer block 22； file and repair the long groove of hammer body 7
		7. Guide rod 26 is curved	Align guide rod

Appendix 2 - Conversion table of concrete strength value of test zone

Rebound value	MPa								
	Impact direction				Horizontal	Impact direction			
	90°	60°	45°	30°	0°	-30°	-45°	-60°	-90°
20	10.3	10.3	10.3	10.3	10.3	13.1	13.7	14.3	14.9
21	10.3	10.3	10.3	10.3	11.4	14.3	14.9	15.5	16.2
22	10.3	10.3	10.3	10.3	12.5	15.4	16.0	16.7	17.4
23	10.3	10.3	10.3	10.4	13.7	16.7	17.4	18.0	18.8
24	10.3	10.3	10.5	11.6	14.9	17.9	18.6	19.3	20.0
25	10.3	10.8	11.6	12.7	16.2	19.2	20.0	20.8	21.5
26	11.0	12.0	12.8	14.0	17.5	20.6	21.4	22.1	22.8
27	11.9	13.3	14.0	15.3	18.9	22.1	22.8	23.6	24.5
28	13.4	14.6	15.4	16.7	20.3	23.5	24.3	25.0	25.9
29	14.8	16.0	16.7	18.0	21.8	25.0	25.9	26.7	27.6
30	16.2	17.5	18.2	19.6	23.3	26.5	27.4	28.2	29.1
31	17.6	18.9	19.6	21.0	24.9	28.2	29.1	30.0	30.9
32	19.1	20.8	21.2	22.7	26.5	29.8	30.7	31.6	32.5
33	20.8	22.0	22.7	24.3	28.2	31.6	32.5	33.5	34.4
34	22.4	23.6	24.5	26.0	30.0	33.3	34.2	35.2	36.1
35	24.1	25.2	26.0	27.8	31.8	35.2	36.1	37.1	38.2
36	25.9	27.1	27.9	29.6	33.6	36.9	37.9	38.9	39.9
37	27.8	28.8	29.6	31.4	35.5	38.9	39.9	41.0	42.0
38	29.6	30.7	31.6	33.5	37.5	40.7	41.8	42.8	43.9
39	31.6	32.5	33.5	35.4	39.5	42.8	43.9	45.0	46.1
40	33.6	34.6	35.5	37.5	41.6	44.8	45.9	47.0	48.1
41	35.5	36.5	37.5	39.5	43.7	47.0	48.1	49.2	50.4
42	37.7	38.7	39.7	41.8	45.9	49.0	50.2	51.3	52.5
43	39.7	40.7	41.8	43.9	48.1	51.3	52.5	53.6	54.8
44	42.0	43.0	44.1	46.3	50.4	53.4	54.6	55.8	57.0
45	44.1	45.2	46.3	48.5	52.7	55.8	57.0	58.2	59.5
46	46.5	47.6	48.7	51.0	55.0	58.0	59.2	60.0	
47	48.7	49.9	51.0	53.4	57.5				
48	51.3	52.5	53.6	56.0	60.0				
49	53.6	54.8	56.0	58.5					
50	56.8	57.5	58.8	60.0					