



User Manual

PCE-HT 224E Concrete Test Hammer



User manuals in various languages (français, italiano, español, português, nederlands, türk, polski, русский, 中文) can be found by using our product search on: www.pce-instruments.com

Last change: 19 December 2023
v1.0

Contents

1	Safety notes	1
2	Specifications	2
2.1	Technical specifications	2
2.2	Delivery scope.....	2
3	System description	3
3.1	Device description.....	3
3.2	Description of the operating keys	4
3.3	Technical data.....	4
4	Measurement parameters	5
4.1	Concrete strength calculation	5
4.2	Concrete strength value in the standard setting.....	5
5	Operation	6
5.1	Start a simple test	6
5.2	Test series in the measurement menu with default settings.....	6
5.3	Calibration.....	8
5.4	Start new measurement	8
5.5	Enter part name	8
5.6	Enter the number of measurements in the test zone.....	9
5.7	Test zone entry	9
5.8	Repeat test of the current test zone.....	11
5.9	„Basic" measurement settings	11
5.10	Review measurement data.....	12
5.11	Delete measurement data	13
6	Data transfer	13
6.1	Set up data transfer.....	13
6.2	Establishing a connection to the PC	14
6.3	Driver installation.....	14
6.4	Starting and exiting the PC software.....	15
7	Main menu	16
7.1	Setting measuring units.....	16



7.2	Setting the upper / lower limit values	16
7.3	Rights management, password settings	17
7.4	Energy saving settings	17
7.5	Date setting.....	18
7.6	Setting the counter	18
7.7	Battery status display	18
7.8	Instrument data (Info of Instrument).....	18
8	Calibration	19
8.1	Completion of a test series	19
9	Maintenance and servicing	20
10	PC software	20
11	Appendix 1 - Troubleshooting	21
12	Appendix 2 - Conversion table for concrete strength.....	24
13	Contact	25
14	Disposal	25

1 Safety notes

Please read this manual carefully and completely before you use the device for the first time. The device may only be used by qualified personnel and repaired by PCE Instruments personnel. Damage or injuries caused by non-observance of the manual are excluded from our liability and not covered by our warranty.

- The device must only be used as described in this instruction manual. If used otherwise, this can cause dangerous situations for the user and damage to the meter.
- The instrument may only be used if the environmental conditions (temperature, relative humidity, ...) are within the ranges stated in the technical specifications. Do not expose the device to extreme temperatures, direct sunlight, extreme humidity or moisture.
- Do not expose the device to shocks or strong vibrations.
- The case should only be opened by qualified PCE Instruments personnel.
- Never use the instrument when your hands are wet.
- You must not make any technical changes to the device.
- The appliance should only be cleaned with a damp cloth. Use only pH-neutral cleaner, no abrasives or solvents.
- The device must only be used with accessories from PCE Instruments or equivalent.
- Before each use, inspect the case for visible damage. If any damage is visible, do not use the device.
- Do not use the instrument in explosive atmospheres.
- The measurement range as stated in the specifications must not be exceeded under any circumstances.
- Non-observance of the safety notes can cause damage to the device and injuries to the user.

We do not assume liability for printing errors or any other mistakes in this manual.

We expressly point to our general guarantee terms which can be found in our general terms of business.

2 Specifications

2.1 Technical specifications

Measurement range	10 ... 100 N/mm ²
Accuracy of the rebound value R	±0.1 R
Display	OLED
Nominal kinetic energy	2.207 J
Compliance	Technical regulations for rebound measurement (JGJ/T23-2001)
Interface	Mini USB
Memory	1000 data units with 256 measurements each
Operating conditions	-4 ... 40 °C
Power supply	3.7 V Li-Ion battery
Power supply (mains adaptor)	Primary: 100 ... 240 V AC, 50/60 Hz Secondary: 5 V DC, 1 A
Dimensions	280 x 75 x 60 mm / 11 x 3 x 2.4 in
Weight	approx. 1.2 kg / 2.6 lbs

2.2 Delivery scope

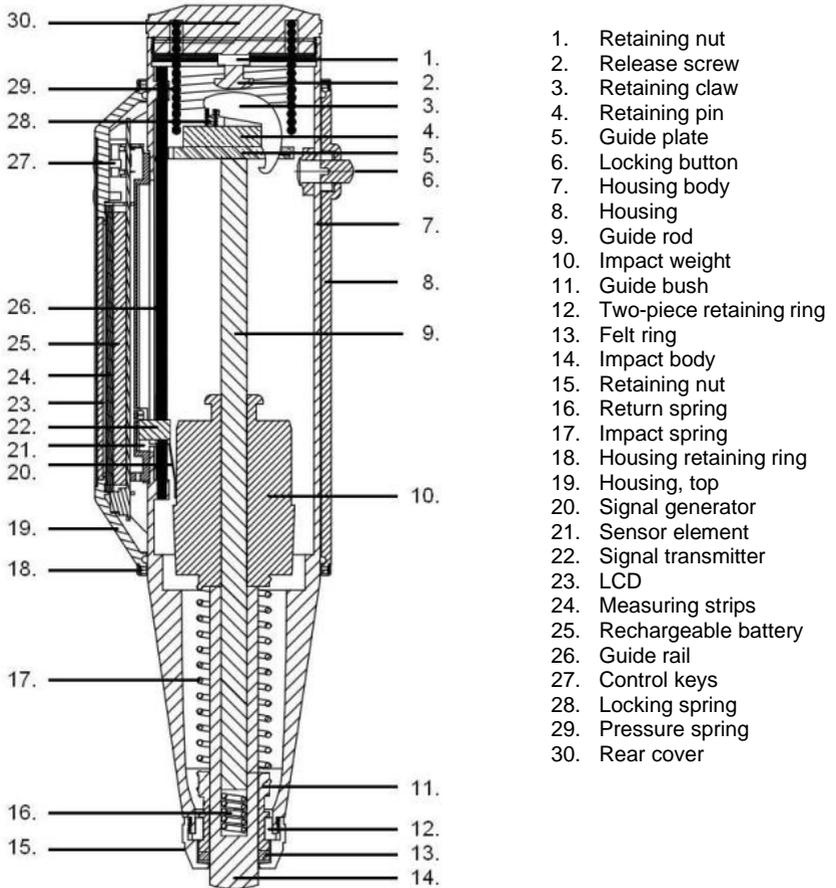
- 1 x PCE-HT 224E material tester
- 1 x mini-USB cable
- 1 x emery stone in storage box
- 1 x charger
- 1 x transport case
- 1 x user manual

The software can be downloaded free of charge from our download area:

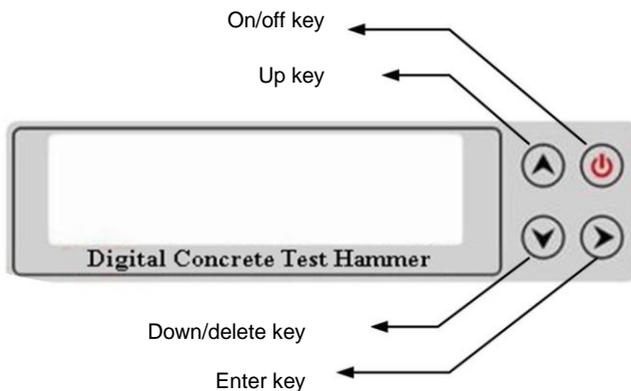
https://www.pce-instruments.com/english/download-win_4.htm

3 System description

3.1 Device description



3.2 Description of the operating keys



3.3 Technical data

Impact energy	2.207 J \pm 0.100 J
Bending stiffness of the return spring	785 \pm 30.0 N/m
Internal length of the sensor	20.0 \pm 0.2 mm
Frictional force of the sensor	0.65 \pm 0.15 N
Radius of the impact body	R 25 \pm 1.0 mm
Active length of the impact spring	61.5 \pm 0.3 mm
Length of the impact body	75.0 \pm 0.3 mm
Display resolution	256 x 64 pixels
Max. number of test zones per component	16
Max. number of test points per test zone	16
Sensor type	contactless optocoupler sensor
Units of measurement, adjustable	MPa, N/mm ² ; kgf/mm ² ; psi
Communication options to the PC	serial interface (optional Bluetooth)

4 Measurement parameters

4.1 Concrete strength calculation

The test angle and the surface of the test zone must be set accordingly if the concrete hardness tester is not in a horizontal position. This allows the device to automatically calculate the corresponding values during the measurement.

Concrete carbonization: The carbonization depth, if known, can be entered and taken into account.

The PCE-HT 224E is able to use 5 different concrete strength curves:

- no standard
- standard, ready-mixed concrete (national standard-pumping)
- standard, in-situ concrete (national standard-non pumping)
- concrete strength curve North America
- user-specific concrete strength curve

4.2 Concrete strength value in the standard setting

Each test zone should be tested 16 times. After 16 tests, the 3 highest and 3 lowest values are cancelled and the average value of the 10 remaining tests is calculated. This average value is then the measured value determined for the test zone.

Before starting the test, the test angle and the test direction must be set so that the concrete test hammer automatically takes the corresponding correction values into account.

Concrete strength and standard deviation

After testing the 16 measuring points, the PCE-HT 224E automatically calculates the concrete strength value and the standard deviation. The determined values are saved.

Calculation of concrete strength in customised test mode

If the parameters preset by the user do not correspond to the standard set of rules, these are to be regarded as customised user settings.

Calculation of the average concrete strength value in the test zone

After the test procedure, the maximum and minimum values are not displayed, only the average rebound value.

5 Operation

5.1 Start a simple test

Individual measurements can be carried out immediately without further adjustment. First press the On/Off key, the following is displayed:

0.00R 00.0 MPa

Then unlock the device as follows:

Place the device with the impact body (14) on a firm surface. Now press the device slowly against the surface at a 90° angle.

At the same time, push the locking button (6) to release the lock. The impact body extends out of the housing when you move the device backwards.

To carry out a measurement, place the extended impact body at a right angle to the concrete surface.

Then press the device against the surface to be tested slowly but firmly.

The impact body is tensioned.

When the trigger position is reached, the impact body is released and strikes the surface.



Caution! There is a serious risk of injury if handled incorrectly!

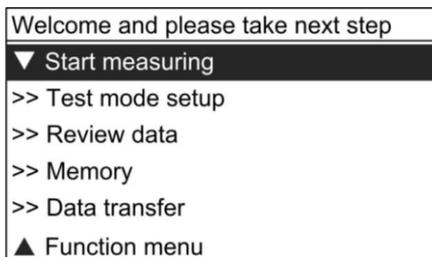
The measurement result is shown on the display as an R value and in MPa.

5.2 Test series in the measurement menu with default settings

After switching on the meter, press the Enter key twice to access the main menu.

The following line appears:

"Welcome and please take the next step"



Then use the arrow down key to select "Test mode setup" and confirm with "Enter".

Once you have made your entry, test mode is switched on and you cannot return to a higher level of the selection menu without further ado.

You can set the following values here:

- Component name: e.g. GJXX
- Number of test procedures: (16)
- Number of test zones: (16)
- Concrete type: e.g. GB standard-pumping (ready-mixed concrete)
- Test angle: e.g.: 0° (horizontal)
- Test direction: top (from above), bottom (from below), side (sideways)
- Carbonization depth: e.g. 0.0 mm (standard setting)

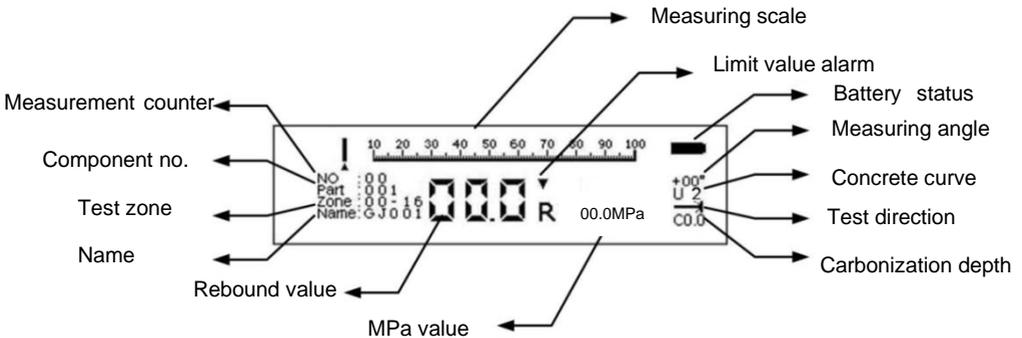
Once the setting has been completed, confirm it with "Enter" and return to test mode. The device has automatically saved the measurement parameters.

An unfinished test can be continued after switching the device off and on again.

The test parameters can be changed during the test. To do this, press the Enter key to access the main menu, then select "Test mode" and continue to the "Testing zone set" selection window. When the set number of rebound tests has been made, the display shows "Testing zone is completed" and the next test series can be started after a 3-second pause.

The test series is completed after the last test of the last test zone.

The tester then automatically switches to the evaluation area. You can then view the test ranges and results in this area.



5.3 Calibration

Calibration is carried out to check the accuracy of the device and to correct it if necessary. For this purpose, 16 test procedures must be carried out on a calibration unit intended for this purpose.

After the 16th test procedure, press "Enter" to confirm. The determined value is displayed. If the measured value of the device deviates too much from that of the calibration unit, see item 11 Appendix 1 - Troubleshooting.

5.4 Start new measurement

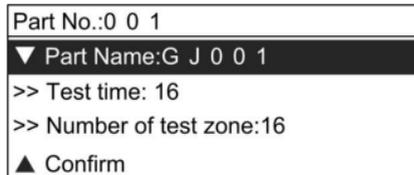
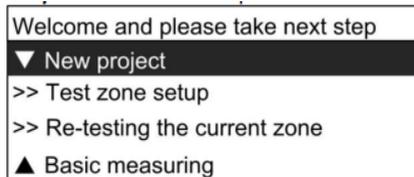
Use the arrow down key to select "New project" and confirm your selection with "Enter". A new test series is created.

The default settings for the new test series are as described below:

Component name like G J X X X, e.g. G J 0 0 1

Number of tests like xx, e.g. 16

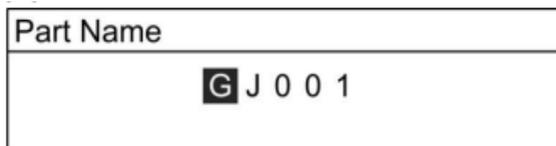
Number of test zones like xx, e.g. 16



5.5 Enter part name

In the "New part" menu item, use the arrow keys to select the "Part name" sub-menu and confirm with "Enter" to enter the name. Set each individual digit using the arrow up key. There are 36 different options for each digit, from 0 - 9 and from A - Z.

Use the arrow down key to select the next digit.



5.6 Enter the number of measurements in the test zone

Enter the number of tests (test time) in the "New part" menu item using the arrow keys. Use the arrow key to select a number between 8 and 16 and confirm your selection with "Enter".

Test time
1 6

After completing the entry, confirm it with "Enter" and continue to the test area selection.

5.7 Test zone entry

There are 4 important parameters that need to be set here: the test angle, the direction of impact to the surface, the depth of carbonization and the concrete strength curve.

New test zone 01
▼ Test angle: HZ 0
>> Pouring surface: SIDE
>> Carburized depth: 0.0 mm
>> Strength curve: U2
▲ Confirm

5.7.1 Setting the test angle

There are 4 important parameters for the "Test zone". Use the arrow keys to select the test angle and confirm with "Enter". A total of 9 different angles are possible here.

Confirm your selection with "Enter" and return to the parameter overview window.

Test angle
▼ Upward +90°
>> Upward +60°
>> Upward +45°
>> Upward +30°
>> Horizontal 0°
>> Downward -30°
>> Downward -45°
>> Downward -60°
▲ Downward -90°

5.7.2 Enter test surface

In the entry menu for the measurement parameters of a new test zone, "Test zone setup", the measurement directions can be selected using the arrow keys. Three measuring directions are possible here: top surface, bottom surface, side surface.

Press "Enter" to confirm and return to the measurement parameter menu.

Test surface
▼ Top surface
>> Bottom surface
▲ Side surface

5.7.3 Setting the carbonization depth

In the selection menu for the "Carburized depth", the carbonization depth can be set within the range from 0.0 to 6.0 mm, using the arrow keys. 13 different settings are possible here: 0.0 mm, 0.5 mm, 1.0 mm, 1.5 mm, 2.0 mm, 2.5 mm, 3.0 mm, 3.5 mm, 4.0 mm, 4.5 mm, 5.0 mm, 5.5 mm, 6.0 mm.

Confirm your entry with "Enter" and return to the "Test zone setup" menu.

Carburized depth
0.5mm

5.7.4 Setting the strength curve

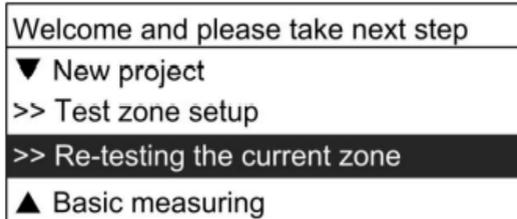
In the "Strength curve" menu, use the up and down arrow keys to select the required concrete strength curve. Then confirm the selection with "Enter". This will also take you back to the "Test zone setup" menu.

Strength curve
▼ No standard
>> GB standard-Pumping
>> GB standard-Non-Pumping
>> North America curve
▲ Users curve

Once the setting is complete, confirm it with "Enter" and return to measuring mode.

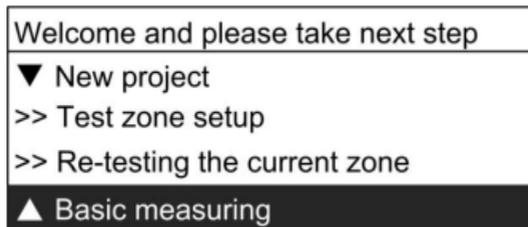
5.8 Repeat test of the current test zone

Press "Enter" to return to the main menu. Then select "Test mode setup" and confirm with "Enter" to access the selection window for the test mode. Select "Re-testing the current zone" and press "Enter" to return to the test zone. The display is then reset to zero.

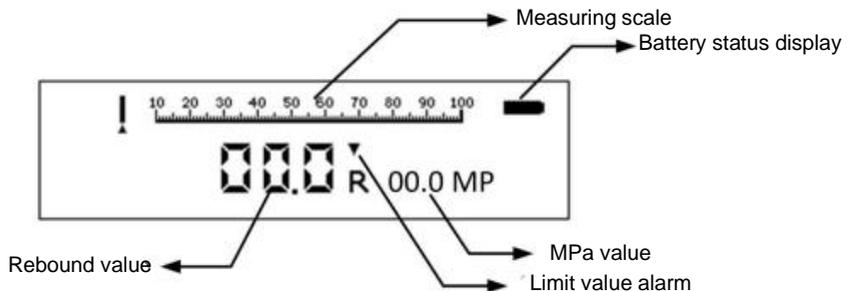


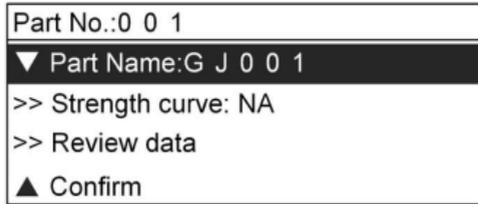
5.9 „Basic" measurement settings

Press "Enter" to access the main menu. Select "Test mode setup" and confirm with "Enter". Then select "Basic measuring" and confirm with "Enter".



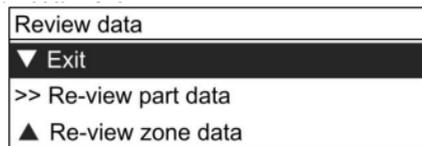
In this setting, only the measuring scale, the rebound value, the MPa value, the limit value alarm and the battery level indicator are displayed on the LCD. In this setting, 100 rebound measurements can be recorded at a time. This data can then be called up and displayed. When the memory is full, a new file is automatically created.



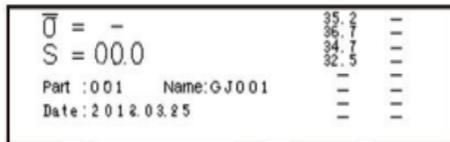


5.10 Review measurement data

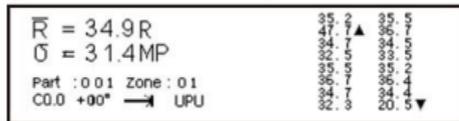
Press "Enter" to access the main menu. Then select "Review data" and press "Enter" to access the review menu.



- 1) Exit the current menu and call up the measurement menu
- 2) View part data
- 3) View the measured values of fully tested parts



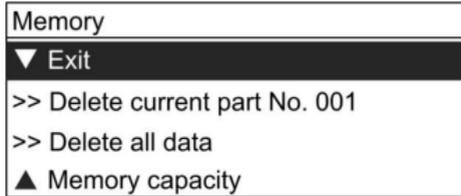
- 4) View the measurement data of complete test zones



The data of the test zones of the last few tests are displayed on the LCD screen. The selection is made using the arrow keys; the menu can be exited by pressing the "Enter" key.

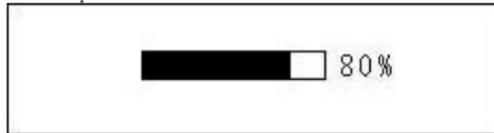
5.11 Delete measurement data

Press "Enter" to open the main menu. Then select "Memory" and confirm with "Enter" to access the memory management.



You have the following options here:

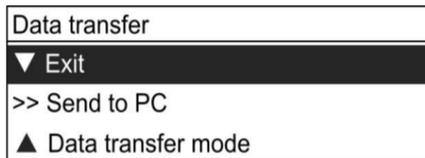
- Exit: Exit the current menu item and switch to measurement view
- Delete current part No. xxx: Remove the data record for the current part
- Delete all data: Delete all saved data records
- Memory capacity: Display of the current memory capacity in per cent 0 ... 100 %; the total storage capacity is up to 1000 data records for components.



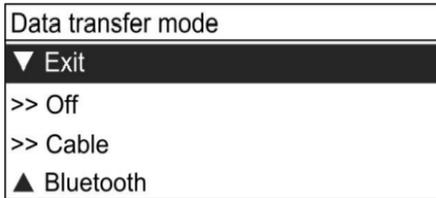
6 Data transfer

6.1 Set up data transfer

Press "Enter" to access the main menu. Then select "Data transfer" and confirm with "Enter". You are now in the data transfer menu.



First connect the PCE-HT 224E to the PC using the mini-USB cable, then select the "Data transfer mode" menu and select "Cable". The "Bluetooth" option for wireless connection is not available. Selecting "Off" would switch off a Bluetooth connection.



Then select "Send to PC". The message "Transferring" appears on the display. The device is now ready for data transfer.

The software is intended for reading out and editing the test data of the PCE-HT 224 E concrete test hammer. The test data can be read out and saved and reports can be created and printed out.

System requirements:

- a PC with USB interface
- Windows XP, Win 7, Win 8, NetFramework 2.0, Win 10 and higher

6.2 Establishing a connection to the PC

Carry out the following steps to connect the concrete test hammer to the PC.

1. Connect the two devices using the mini USB cable supplied.
2. Switch on the concrete test hammer and press the Enter key to access the main menu. Select the menu item "Data Transfer" > "Data Transfer Mode" > "USB Cable".
3. Select "Data transfer" > "Send to PC". "Transferring" appears on the display and the data transfer begins.

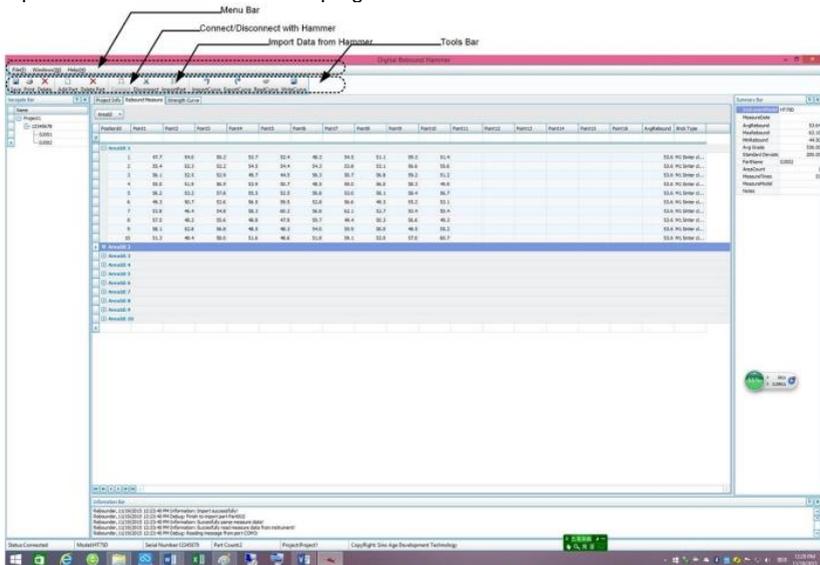
6.3 Driver installation

"Found new Hardware" appears on the computer screen when the concrete test hammer is connected to the PC for the first time. Copy the drivers to the directory X:/ Driver folder (software installation).

Install the "Digital Rebound Hammer" software by double-clicking on "Setup\setup.exe".

6.4 Starting and exiting the PC software

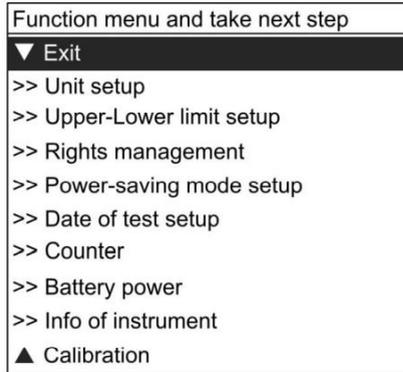
Once the software has been successfully installed, a shortcut will automatically appear on the desktop. Double-click on it to start the programme.



The main view of the software is in standard Windows format and contains the title bar, the menu bar and the toolbar. The software can be used to analyse and document the measured assemblies and components, e.g. as an attachment to acceptance reports.

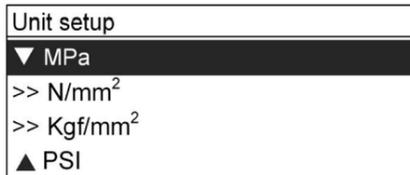
Important: Once the software has been installed, activate the connection between the PC and the rebound hammer via "CONNECT"!

7 Main menu



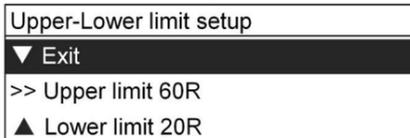
7.1 Setting measuring units

Select the various units via the "Unit setup" menu.



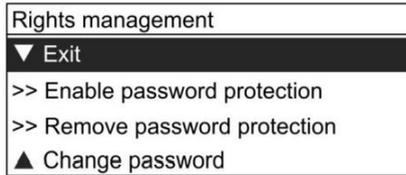
7.2 Setting the upper / lower limit values

Set the upper and lower limit values via the "Upper-Lower limit setup" menu.



The upper and lower limit values of the rebound value (00 ... 60) are set here. Use the up and down arrow keys to select the settings and confirm and save them with "Enter".

7.3 Rights management, password settings

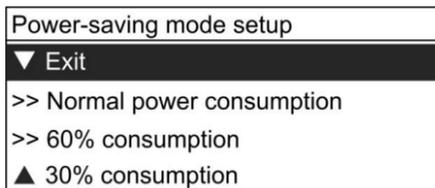


Under the "Rights management" menu item, you can activate or remove password protection or change the password. The password is then valid for data retrieval, limit value entry and rights management.

Use the arrow down key to move the pointer to the next letter, use the arrow up key to set the numbers from 0 to 9 and then confirm with the Enter key.

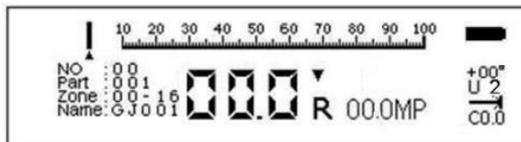
7.4 Energy saving settings

In the "Power-saving mode setup" menu, select the desired settings using the arrow keys and confirm them with "Enter".



In this menu item, you will find 3 selection options:

Normal energy consumption, i.e. approx. 8 - 10 hours operating time when the device is fully charged



Reduced operation, energy consumption approx. 60 %; in this setting approx. 10 - 13 hours operating time is common when the device is fully charged



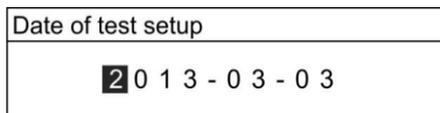
Economy mode, energy consumption approx. 30 %; approx. 13 - 16 hours operating time is common in this setting when the device is fully charged



In the energy saving settings, you can switch back to the normal energy setting by pressing "Enter". If you then press "Enter" again and then start the measurement, you will return to the preset energy-saving modes.

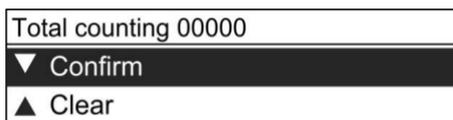
7.5 Date setting

Set the date in the "Date of test setup" menu. To do this, press the arrow down key to move the cursor to the right and use the arrow up key to set the current digit.



7.6 Setting the counter

Select the "Counter" setting. Here you can see the number of saved test procedures. You can also reset the number of test procedures in this view. If you select "Clear" and confirm with "Enter", the display is reset to zero.



7.7 Battery status display

The battery capacity is displayed in per cent (0 ... 100 %).

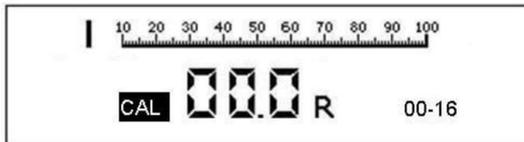
7.8 Instrument data (Info of Instrument)

Display of device data (serial number and firmware version)

8 Calibration

After repair or service work, the device calibration can be checked in the "Calibration" setting. To do this, use the up and down arrow keys to select the "Calibration" setting and confirm with "Enter". Then carry out a total of 16 test procedures on a test anvil intended for this purpose. After completing the 16 test procedures, confirm them with the Enter key.

The following is displayed:

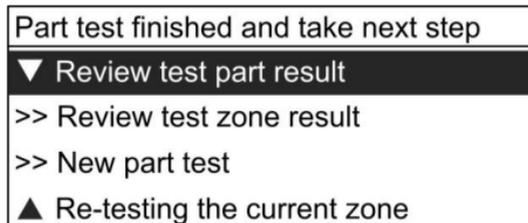


The device is now calibrated and the display shows the zero position.

8.1 Completion of a test series

Once a test zone has been completed, the device automatically switches to the next test zone. When all test zones have been measured, the device switches to the "Part test finished and take next step" display area (completion of a test series). This completes the current series of measurements.

You will see the menu items in the display: Review test part result, Review test zone result, New part test, Re-testing the current zone.



In the "Review test zone result" view, the measurement results are displayed on the right-hand side and the associated measurement parameters at the bottom left.

Ave. rebound = 233	4 0 8	4 6 7
Zone intensity = 44	4 5 9	3 8 9
Part : 0 0 4	2 4 6	4 4
Zone: 0 1	4 0 3	4 8 5
+ 0 0 °	3 2 6	5 2
PU	3 8 6	6 2
	1 6 3	1 8 3
	2 2	2 5 9

View results in the test area

In the "Review test part result" view, the test results of each test area can be seen on the right-hand side of the display. The name and numbering can be found at the bottom left.

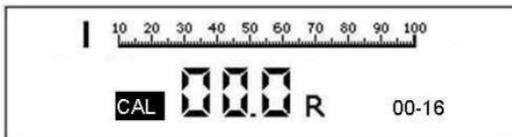
9 Maintenance and servicing

Maintenance measures are important for the PCE-HT 224E concrete tester under the following conditions.

- More than 2000 rebound tests
- Inconclusive test results
- Number of rebound tests performed unknown

Simple maintenance measures can be carried out as described below:

- Dismantle the untensioned hammer, open the upper housing by turning the knurled screw at the upper (thick) end anti-clockwise and remove the rebound spring, the firing pin and the measuring unit. To do this, you must also loosen the retaining nut at the front end and remove the felt seal and the bearing shells. Then carefully remove the guide rod with impact weight and impact body. To do this, gently push in the locking hook and pull out the unit. Note the positions of the guide rails and the locks for subsequent reassembly.
- Carefully clean all internal components with compressed air, then slightly oil the central guide tube.
All other components must not be oiled.
- Clean the inside wall of the housing carefully. The holding torque of the locking unit should be approx. 0.5 ... 0.8 Nm.
- The retaining nut (large knurled screw) must no longer be able to be turned; it must be slightly tightened.
- Self-manufactured spare parts must not be used.
- After repairs have been carried out, a self-calibration must be performed (see also 5.3 Calibration). The rebound value should be 80 ± 2 .
Select the calibration function, then carry out the test procedure 16 times on the corresponding calibration anvil in this setting. Then confirm with "Enter" to save the calibration and exit this setting.



10 PC software

See chapter 6 Data transfer.

11 Appendix 1 - Troubleshooting

If the display value suddenly stops changing during operation of the device or the rebound value shows a large deviation, a mechanical fault has usually occurred. The troubleshooting options are listed in the table below:

The replacement of parts or the mechanical repair of components may only be carried out by authorised specialist personnel!

	Error	Cause	Repair method
I	During the function check, the signal transmitter (22) blocks at the starting point.	1. The distance between the signal generator (20), signal transmitter (22) and guide rail (26) is too small.	Dismantle the signal transmitter (22) and carefully change the angle of the signal generator (20).
		2. The signal generator (20) is broken.	Dismantle the signal transmitter (22) and replace the signal generator (20).
II	The signal transmitter (22) is already pushed up before the rebound test and displays the rebound value.	1. The contact angle between the signal generator (20) and the signal transmitter (22) is too large.	Dismantle the signal transmitter (22) and carefully bend the contact angle of the signal generator (20) together.
		2. The clearance between the signal transmitter (22) and the guide rail (26) is too large.	Remove the signal transmitter (22) and set the frictional force between the signal transmitter (22) and the guide rail (26) (0.65 ± 0.15 N).
III	During the rebound process, the signal transmitter (22) shakes, moves to a certain point and blocks there.	The signal transmitter (22) rubs or jumps against the housing body.	Dismantle the signal transmitter (22) and carefully smoothen the guides with a small file.
IV	The impact weight (10) triggers too early.	1. The retaining claw (3) is blunt.	Sharpen the edge of the retaining claw (3) with a file.
		2. The detent on the impact weight (10) is broken/worn.	Change the angle of the impact weight (10) or replace it.
V	The rebound device cannot be pushed back and the impact weight (10) does not move back.	1. The locking spring (28) does not engage and does not catch the retaining claw.	Refit the locking spring (28) or restore the tension and position by bending it open.
		2. The end of the retaining claw (3) is broken.	Replace the retaining claw (3).
		3. The end of the retaining claw (3) is worn.	Carefully grind the retaining claw (3) back into shape.

VI	The impact weight (10) is stiff or does not release.	1. The thick end of the retaining claw (3) touches the surface of the impact weight (10).	Grind 1 mm off the thick end of the retaining claw (3).
		2. The retaining claw (3) is too sharp-edged.	Grind the catch hook of the retaining claw (3) to the right angle.
VII	The impact body (14) does not move and does not extend, device does not work.	The locking button (6) is loose, the small spring in the inner part is not working properly.	Hold one end of the coil spring and twist the spring 30 times to restore the tension. Then refit the spring into the locking button (6).
VIII	The rebound value is relatively high.	1. The impact spring (17) is longer than 61.5 mm.	Adjust the position of the impact spring (17) in the guide bushing (11).
		2. The starting position of the impact weight (10) is relatively high. The impact spring (17) is too long.	Turn the adjusting bolt on the back of the housing (30) outwards.
		3. There is too much oil on the guide rod (9).	Dismantle the relevant components of the rebound body, clean them with a soft cotton cloth and then slightly oil them.
IX	The rebound value is relatively low.	1. The impact spring (17) is shorter than 61.5 mm.	Adjust the position of the impact spring (17) on the guide bushing (11).
		2. The starting position of the impact weight (10) is relatively low.	Turn the adjusting bolt on the back of the housing (30) inwards.
		3. The friction of the signal transmitter (22) is relatively high.	Set the distance angle between the signal transmitter (22) and the guide rail (26) accordingly and set a friction value of 0.65 ± 0.15 N.
		4. The impact weight (10) is dirty.	Clean the impact weight thoroughly.
		5 The friction between the impact weight (10) and the guide rod (9) increases.	Slightly oil the guide rod (9).

X	The rebound value is unstable and fluctuates significantly.	1. The contact surface between the impact weight (10) and the impact body (14) is uneven.	Rotate the impact body (14) by 180° or replace it.
		2. The centre guide rod (9) is dirty.	Dismantle and clean the device and then oil it slightly.
		3. The centre guide rod (9) is bent.	Align the guide rod (9) accordingly.
		4. The friction between the signal transmitter (22) and the guide rail (26) is not the same.	Adjust the friction between the signal transmitter (22) and the guide rail (26).
		5. The contact between the signal generator (20) and the impact weight (10) is poor.	Adjust the angle of the signal generator (20) accordingly.
		6. The guide rail (26) rubs or strikes against the housing body (7).	Carefully smoothen the surfaces of the signal transmitter (22) with a lapping stone; also smoothen the guide channel on the housing body if necessary.
		7. The guide rail (26) is bent.	Realign the guide rail.

12 Appendix 2 - Conversion table for concrete strength

Rebound value	Concrete compressive strength in MPa = N/mm ² for the direction of impact								
	top				horizontal	downwards			
	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	24.5	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	31.6	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	43.7	43.9	45.0	46.1
40	33.6	34.6	33.5	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					

13 Contact

If you have any questions, suggestions or technical problems, please do not hesitate to contact us. You will find the relevant contact information at the end of this user manual.

14 Disposal

For the disposal of batteries in the EU, the 2006/66/EC directive of the European Parliament applies. Due to the contained pollutants, batteries must not be disposed of as household waste. They must be given to collection points designed for that purpose.

In order to comply with the EU directive 2012/19/EU we take our devices back. We either re-use them or give them to a recycling company which disposes of the devices in line with law.

For countries outside the EU, batteries and devices should be disposed of in accordance with your local waste regulations.

If you have any questions, please contact PCE Instruments.



PCE Instruments contact information

Germany

PCE Deutschland GmbH
Im Langel 26
D-59872 Meschede
Deutschland
Tel.: +49 (0) 2903 976 99 0
Fax: +49 (0) 2903 976 99 29
info@pce-instruments.com
www.pce-instruments.com/deutsch

United Kingdom

PCE Instruments UK Ltd
Trafford House
Chester Rd, Old Trafford
Manchester M32 0RS
United Kingdom
Tel: +44 (0) 161 464902 0
Fax: +44 (0) 161 464902 9
info@pce-instruments.co.uk
www.pce-instruments.com/english

The Netherlands

PCE Brookhuis B.V.
Institutenweg 15
7521 PH Enschede
Nederland
Telefoon: +31 (0)53 737 01 92
info@pcebenelux.nl
www.pce-instruments.com/dutch

France

PCE Instruments France EUURL
23, rue de Strasbourg
67250 Soultz-Sous-Forets
France
Téléphone: +33 (0) 972 3537 17
Numéro de fax: +33 (0) 972 3537 18
info@pce-france.fr
www.pce-instruments.com/french

Italy

PCE Italia s.r.l.
Via Pesciatina 878 / B-Interno 6
55010 Loc. Gragnano
Capannori (Lucca)
Italia
Telefono: +39 0583 975 114
Fax: +39 0583 974 824
info@pce-italia.it
www.pce-instruments.com/italiano

United States of America

PCE Americas Inc.
1201 Jupiter Park Drive, Suite 8
Jupiter / Palm Beach
33458 FL
USA
Tel: +1 (561) 320-9162
Fax: +1 (561) 320-9176
info@pce-americas.com
www.pce-instruments.com/us

Spain

PCE Ibérica S.L.
Calle Mula, 8
02500 Tobarra (Albacete)
España
Tel. : +34 967 543 548
Fax: +34 967 543 542
info@pce-iberica.es
www.pce-instruments.com/espanol

Turkey

PCE Teknik Cihazları Ltd.Şti.
Halkalı Merkez Mah.
Pehlivan Sok. No.6/C
34303 Küçükçekmece - İstanbul
Türkiye
Tel: 0212 471 11 47
Faks: 0212 705 53 93
info@pce-cihazlari.com.tr
www.pce-instruments.com/turkish

Denmark

PCE Instruments Denmark ApS
Birk Centerpark 40
7400 Herning
Denmark
Tel.: +45 70 30 53 08
kontakt@pce-instruments.com
www.pce-instruments.com/dansk