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Manual Durometer PCE-1000



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Contents

1	Introduction	3
1.1	General	3
1.2	Measuring method	3
2	Safety notes	4
3	Specifications	5
4	System description	5
4.1	Device	5
4.2	Display	6
5	Explanations	6
6	Operation	7
6.1	Preparations before the measurement	7
6.1.1	Sample	7
6.1.2	Coupling	8
6.2	Operation diagram	8
6.3	Switch on	9
6.4	Menu	9
6.4.1	Direction of impact	9
6.4.2	Material settings	9
6.4.3	Hardness scale	9
6.4.4	Mean time	10
6.4.5	Storage	10
6.4.6	Read out / delete stored data	10
6.4.7	Check out the serial number	10
6.4.8	Restore factory settings	11
6.4.9	Return to measurement mode	11
6.5	Measurement	11
6.6	Show statistical values	12
6.7	Calibration	12
6.8	How to charge the battery	12
7	Disposal	13
8	Contact	13
8.1	PCE Instruments UK	13
8.2	PCE Americas	13

1 Introduction

1.1 General

Thank you for purchasing a durometer PCE-1000 from PCE Instruments. The PCE-1000 portable hardness tester is ideal for testing the surface hardness of metallic surfaces quickly. In metallurgy, it's very important to know the hardness of the materials being used and this device allows for the materials to be tested in the factory. The hardness tester brings together the parameters of Rockwell B & C, Vickers HV, Brinell HB, Shore HS and Leeb HL.

Thanks to its portability, this hardness meter is very useful in production, quality control and technical service. Its compact design and rechargeable battery makes this a very easy device to use. The PCE-1000 hardness tester can be used in any position but doesn't have the capability to transfer or store data.

1.2 Measuring method

The measuring method by Leeb has first been applied in 1978. It is defined by the ratio the rebound speed of an impacting object and its impact speed multiplied by 1000. The harder the surface of the material is, the higher the rebound speed. The Leeb hardness value is able to make a direct connection between a group of materials (e.g. aluminium, steel,...) and its attributes.

For the most common metallic parts there are conversion tables which help to transfer HL-values in other hardness units (HB, HV, HRC, etc.)

A hydraulic impactor with a spherical measuring tip (tungsten carbide) is skidded towards the surface and it then rebounds back. The impact- and rebound speeds are measured at a distance of 1 mm from the surface to be measured by making use of the following method:

A hydraulic impactor with an assembled permanent magnet induces an electric voltage when passing the coil. The electric voltage has a proportional ratio to the velocity of the magnet.

Leeb hardness values can be calculated by using the following formula:

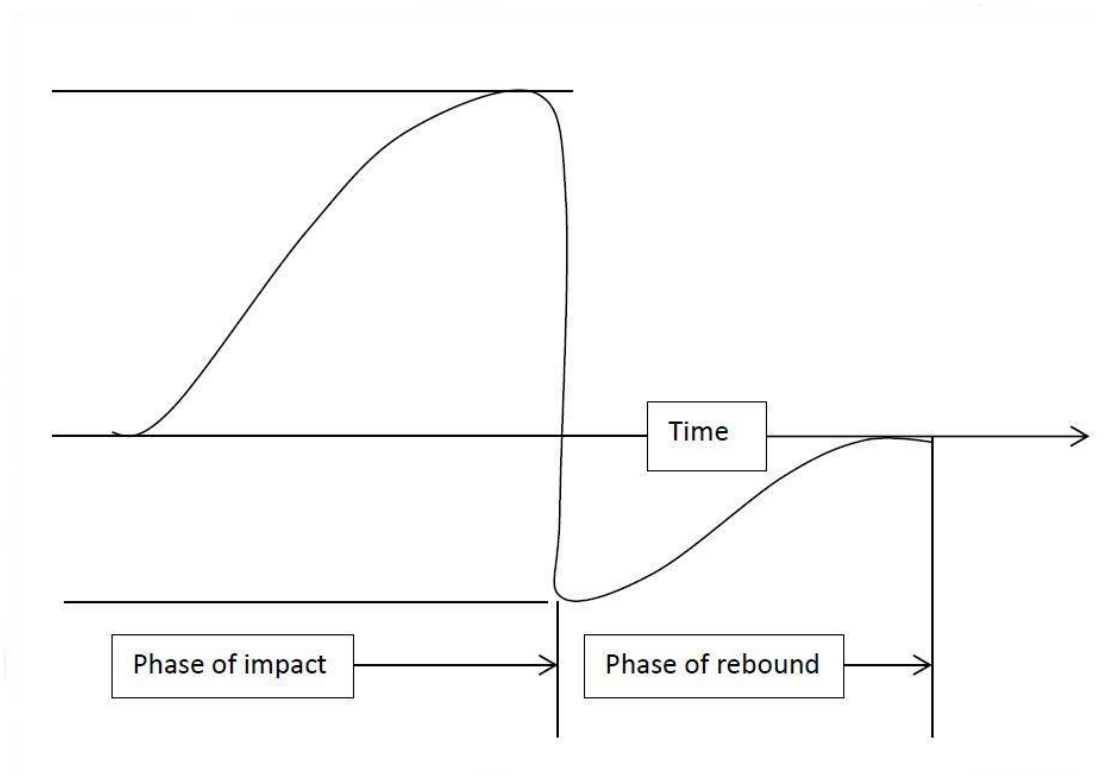
$$HL = 1000 \times (V_B / V_A)$$

HL : Hardness by Leeb

V_B : Velocity back

V_A : Velocity at arrival

Here you can see the stress curve when the hydraulic impactor passes the induction coil.



If the hardness of a material is measured with the conventional statistically method, the measured value is influenced by the pressure applied (720 HLD \neq 720 HLC). Different hydraulic impactors will lead to different exchange tables, you should always refer to the hydraulic impactor used.

2 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. There is no warranty of damages or injuries caused by non-observance of the manual.

- The device may only be used in approved temperature range
- The opening of the case should only be done by qualified personnel of the PCE Instruments.
- You should not make technical changes on the device
- The appliance should only be cleaned with a damp cloth / use only pH-neutral cleaner
- Always store the device in a cool, dry place.

This user's handbook is published from PCE Instruments without any guarantee.

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

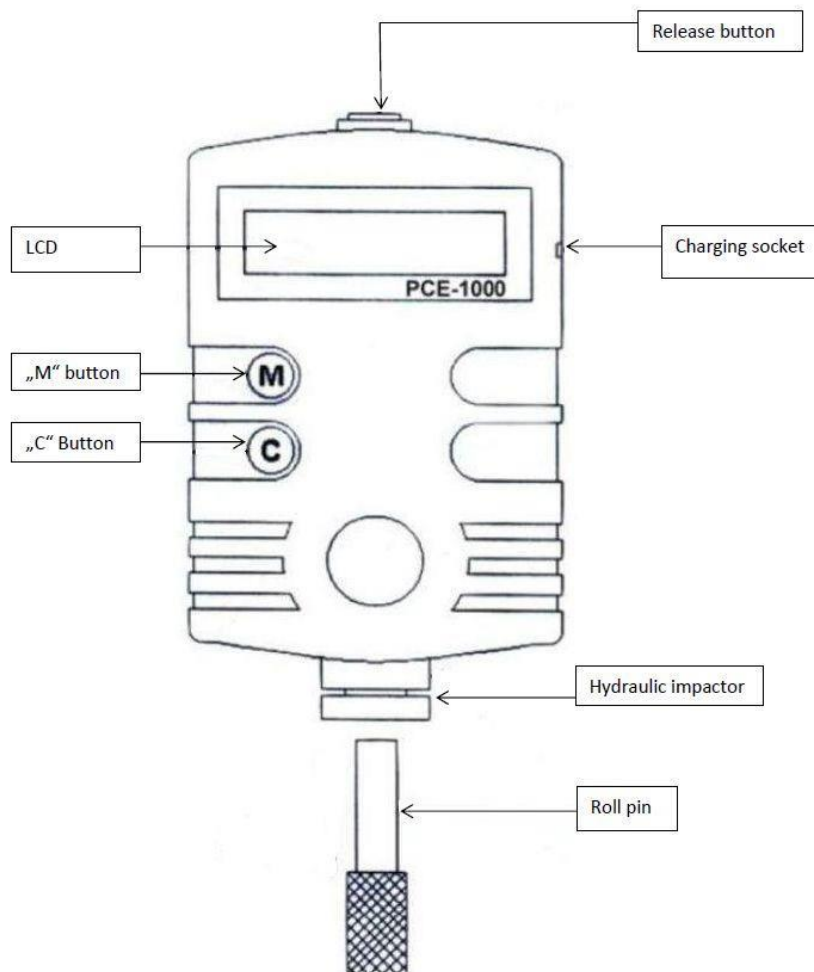
If you have any questions please contact PCE Instruments.

3 Specifications

Display	LCD with backlight display
Accuracy	± 3 HL @ HL = 800 (0,4 %)
Measurement range	170...960 HL
Measured units	HL, HRC, HRB, HB, HV, HS, HRA, σ_b
Materials	9 different usable materials
Storage	99 records
Hydraulic impactor	D
Power	Automatically
Power supply	DC 9 V Ni-MH Akku
Surrounding temperature	0 ... +50 °C
Max. temperature of the samples	120 °C
Minimum hardness layer	0,8 mm
Minimal thickness of the sample	3 mm
Dimensions	100 x 60 x 33 mm
Weight	150 g

4 System description

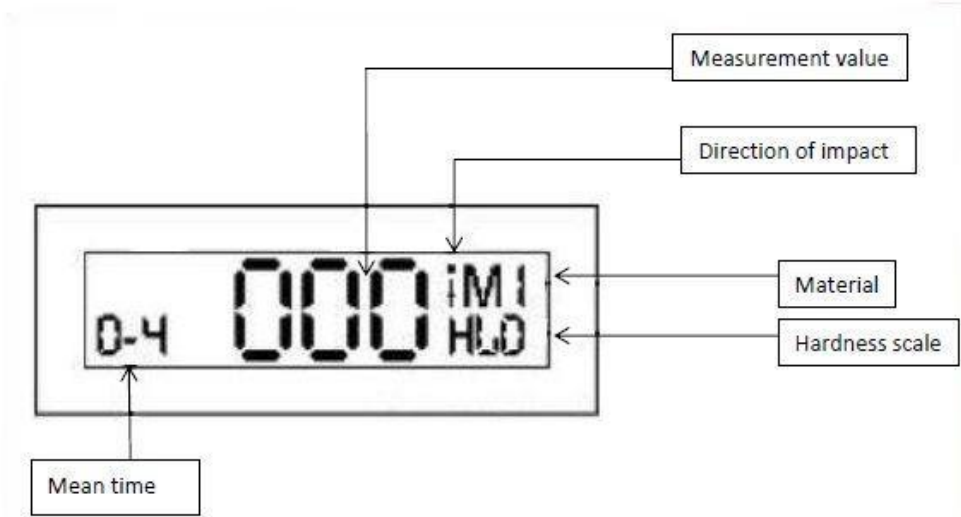
4.1 Device



“M”-Button: Menu, Calculation of average and MIN/MAX, adjustment upwards

“C”-Button: change settings, delete outliers, adjustment downwards, retrieve storage

4.2 Display



5 Explanations

Symbol	Meaning
LD	Leeb hardness value with a hydraulic impactor D
HB	Brinell hardness value
HRB	Rockwell B hardness value
HRC	Rockwell C hardness value
HSD	Shore hardness value
HV	Vickers hardness value
σ_b	Tensile strength

	HLD: 170-960				
	HRC	HRB	HB	HV	HSD
Steel	20,0 – 67,9	59,6 – 99,5	80 – 647	80 – 940	32.5 – 99.5
Tool steel	20,5 – 67,1			80 – 898	
Stainless steel	19,6 – 62,4	46,5 – 101,7	85 – 655	85 - 802	
Grey cast iron			93 – 334		
Spheroidal graphite iron			131 – 387		
Aluminium cast			30 – 159		
Brass		13,5 – 95,3	40 – 173		
Bronze			60 – 290		
Copper			45 – 315		

6 Operation

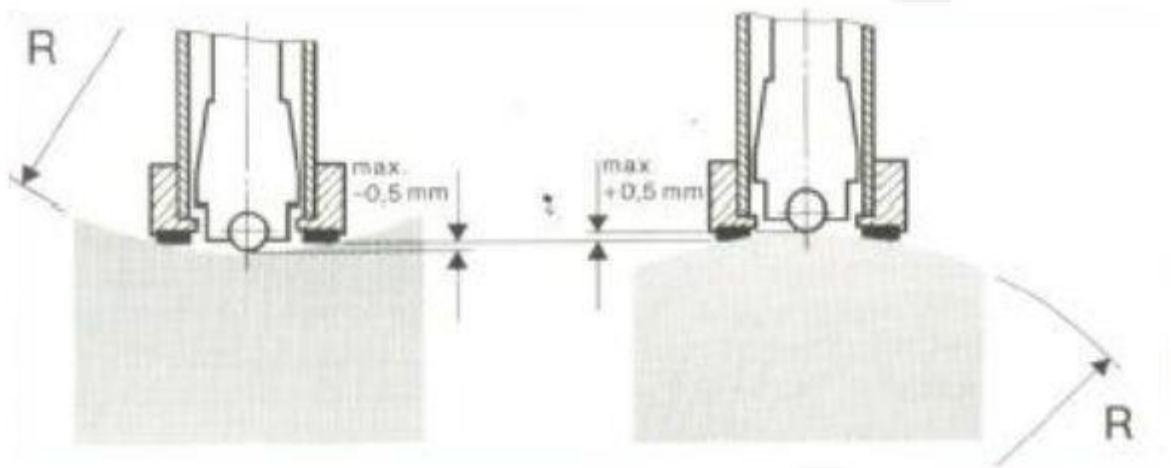
6.1 Preparations before the measurement

6.1.1 Sample

Type of hydraulic impactor	Classification of samples in weight classes		
	Heavy	Medium-weight	Light
D	>5 kg	2 ... 5 kg	0,05 ... 2 kg

Please note that the hydraulic impactor is shortly subjected to a relatively high impact force, considering his low mass and his impact energy, when it impinges on the surface. The maximum impact force for a type D device is 900 Newton.

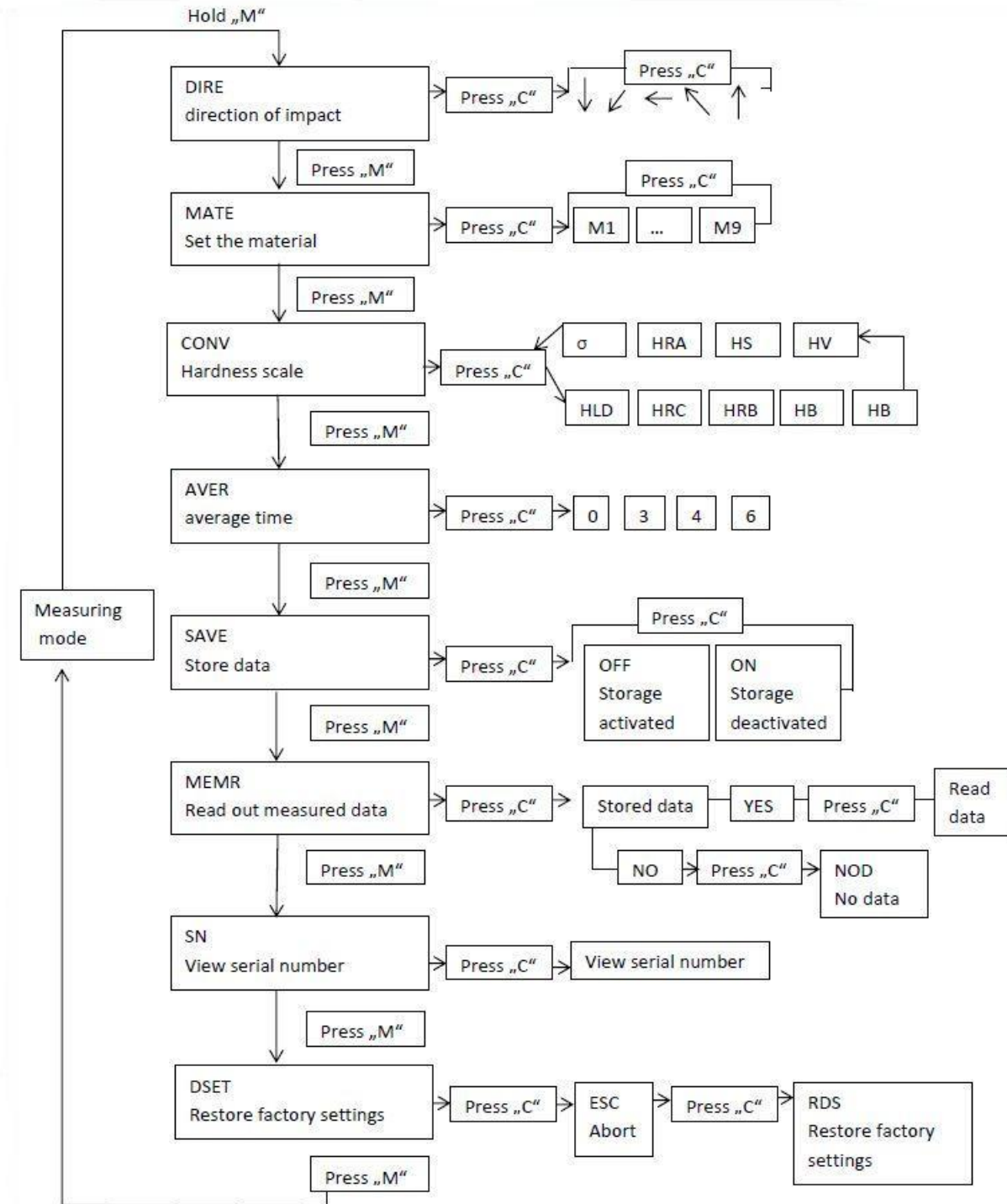
- The surface temperature of the test object should be below 120 °C.
- The test object should obtain a smoothly grinded surface in order to avoid faulty measurements. These faulty measurements may be an effect of rough grinding or grooves by a lath machine.
- The throatiness of the test object shall not exceed 2 µm.
- For test object above 5 kg, which have a compact form, there are no preparations needed,
- Test objects between 2 and 5 kg or heavier objects with protruding parts or thin sides shall be placed on a stable subsurface so they do not break or deform when the hydraulic impactor hits them. If they deform or break the Leeb value may be wrong.
- Note that also bigger test objects may deform if they have thin sides or protruding parts.
- Test objects below 2 kg should be coupled to a stable (above 5 kg heavy) subsurface.
- The hardened layer of the testing object no not be any thinner than 0,8 mm.
- The surface of the test object should not be magnetic.
- Curved surfaces of test objects should at least have a radius 30 mm. Otherwise a supporting ring is needed.
- Measuring instruments that work by using the impact force only work properly when the impactor is at a certain point of the guide tube, when hitting the test object. If spherical or cylindrical objects that are arched to the inside of the test object are measured, the measurement may not be correct.



6.1.2 Coupling

- The coupling surface between test object and base plate should be flat, levelled and straight.
- Apply a thin and evenly layer of coupling compound to the contact surface of the test object.
- Press the test object tightly onto the subsurface by turning it.
- The direction of impact should be vertical to the coupled surface.
- The minimum thickness of the coupling sample is 5 mm.
- In order to perform reliable measurements, the test objects need to be coupled correctly. If that is not the case there discrepancies between the measurements. In addition to that the Leeb-values may be too little and differ and there may be rattling noises when the impactor hits the test object.

6.2 Operation diagram



6.3 Switch on

Press the release button on top of the device and it will switch to measuring mode.

6.4 Menu

Press the “M”—button and hold it. Eventually the word “MENU” blinks. This is how you get to the point where the direction of impact can be set (“DIRE”). Keep pressing “M” until you get to the point where you can set the material attributes (“MATE”), hardness scale (“CONV”) and the mean time (“AVER”). In the end you return to the normal measurement mode.

6.4.1 Direction of impact

When “M”-button has been pressed and you got the point “DIRE”, you will have to press “C” in order to adjust the direction of impact.



6.4.2 Material settings

After reaching the “MATE”-section “C” needs to be pressed until your preferred material is chosen (M1 ... M9)



M1: Steel / cast steel

M3: Stainless steel

M5: Spheroidal graphite iron

M7: Brass

M9: Copper alloy

M2: Cold work steel

M4: Grey cast iron

M6: Aluminium cast

M8: Bronze

6.4.3 Hardness scale

After you got to the point “CONV”, press C until the needed hardness scale (HLD, HRC, HRB, HB, HV, HS, HRA, σ_b) has been selected.



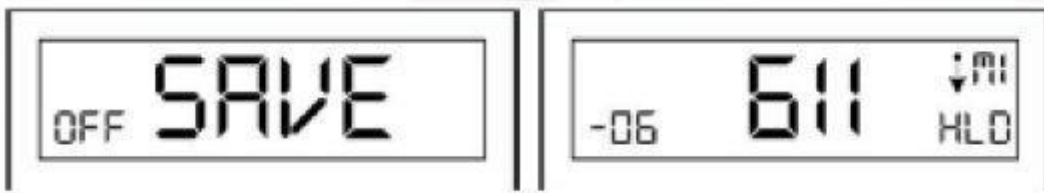
6.4.4 Mean time

After you got to the point "AVER", press C until the desired mean time (0, 3, 4, 5) is reached. By choosing 0 no mean time is set.



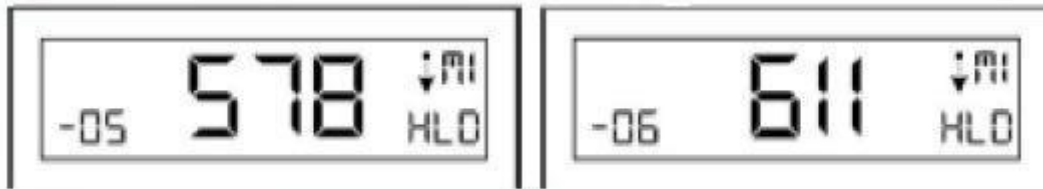
6.4.5 Storage

After you got to the point "SAVE", press C once or twice, depending on if you want switch on or switch off the storage function. It is made possible to save 99 values which can be read out at a later point of time. If the storage function is enabled in the bottom-left corner of the LCD "-00" is displayed. All measured data is stored automatically.



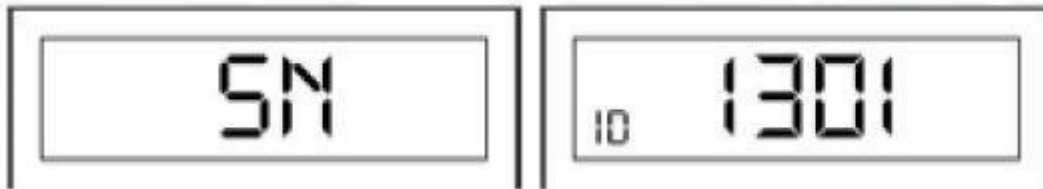
6.4.6 Read out / delete stored data

After you got to the point "MEMR", press C to enter the read-out-mode. Press "M" and "C" simultaneously to view the measured values. If there are no measurement values the LCD will show "NOD". "M" and "C" serve to scroll through the stored data. HOLD "M" and "C" simultaneously for about 5 seconds to exit the read-out mode and delete the measured data.



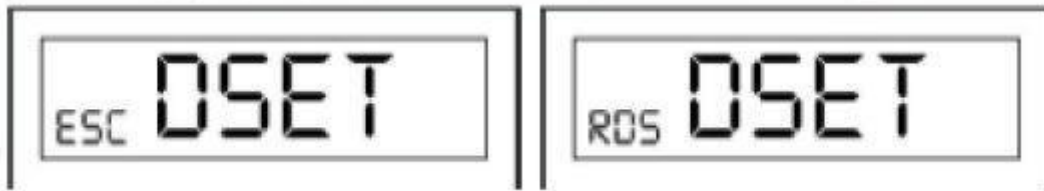
6.4.7 Check out the serial number

After you got to the point "SN", press C to view the serial number. It will be displayed. Press "M" again to get to the next point of the menu.



6.4.8 Restore factory settings

After you got to the point "DSET", press C to choose between "ESC" to abort and "rdS" to restore the factory settings. By pressing "C" you confirm your selection.

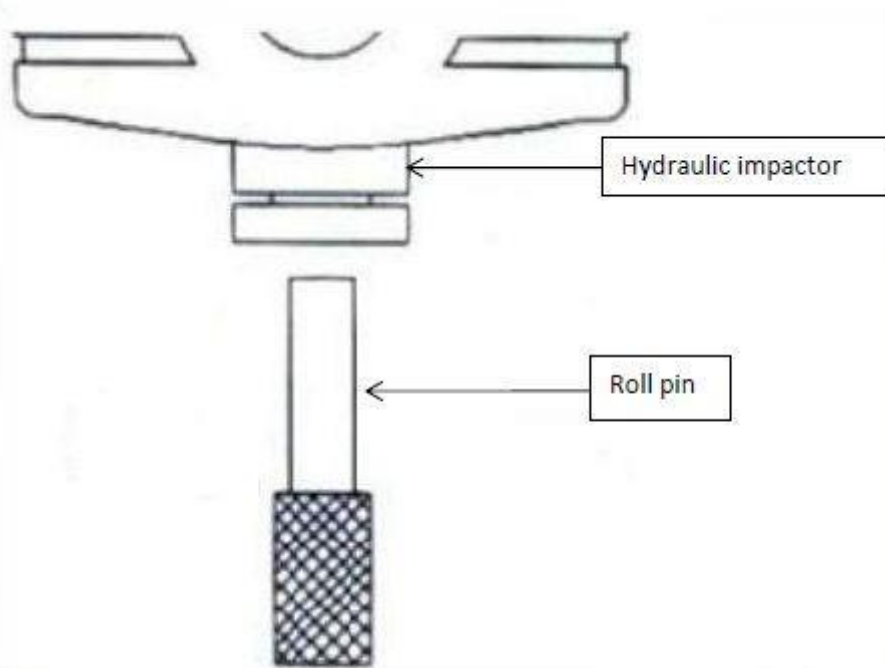


6.4.9 Return to measurement mode

Press "M" once again to return to the measurement mode. The durometer will display "000".



6.5 Measurement



1. Press the release button on top of the durometer to switch it on.
2. Push the roll pin in the slot of the hydraulic impactor until the hydraulic impactor until it locks.
3. Press the durometer tightly onto the surface that is to be measured.
4. Press the release button on top of the durometer to perform a measurement. The measured value is indicated on the LCD.

6.6 Show statistical values

After measuring with certain mean times, press „M“ several times, if needed. By pressing it once the display will indicate the average value, by pressing it twice it will display the maximum value and by pressing it three times, the minimum value will be shown.

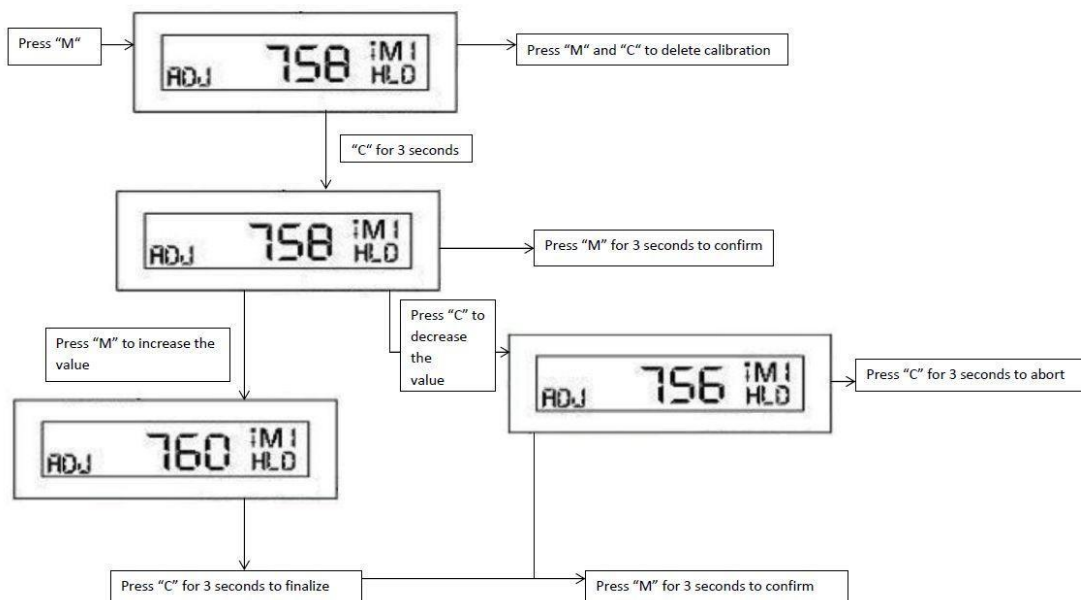


Note: In case there is a value during the measurement which is unrealistic, you have to press “C” in order to erase the value so that it will not be part of the statistical values. Otherwise the calculation of the average will be wrong.

6.7 Calibration

After a certain period of using the durometer, the measuring tip will have suffered from the impacts. This might lead to faulty measurements. In that case we suggest to re-calibrate the device.

- The calibration is based on the HLD scale
- The mean time needs to be set three times
- To calibrate you need to perform three measurements on the test block



- Hold the “C” button until the calibration mode is opened. On the left side of the display “ADJ” is displayed.
- Press “C” or “M” to reduce or increase the standard value.
- Hold “M” to finish calibration.
- Hold “C” to abort without saving the settings.

Please note: If the deviation is not higher than the one written down in the specifications, do not calibrate the device. If the hydraulic impactor is replaced, erase the calibration.

6.8 How to charge the battery

When the battery indicator appears on the LCD, this is to remind you to charge the battery. Measurements can still be taken but the remaining time is limited. To avoid inaccuracies, please make sure to replace or charge the battery. Insert the plug of the battery charger into the socket on the right side of tester. Then connect the battery charger to mains power to start charging the battery. It may take 12-15 hours to fully charge the battery.

7 Disposal

For the disposal of batteries, 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.

If you have any questions, please contact PCE Instruments



8 Contact

If you have any questions about our range of products or measuring instruments please contact PCE Instruments.

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