MESSTECHNIK SaluTron® GmbH

HardyTest D100

OPERATION MANUAL

CONTENTS

1. Forewords

1.1. History

The Leeb measuring method was first brought into measurement technology in 1978. It is defined as the quotient of an impact body's rebound velocity over its impact velocity, multiplied by 1000. Harder materials produce a higher rebound velocity than softer materials. For a specific group of material (e.g. steel, aluminum. etc.), Leeb hardness value represents a direct relationship to its hardness properties. For ordinary metal, conversion curves of hardness HL versus other standard static hardness (HB, HV, HRC, etc.) are available, enabling you to convert HL into other hardness values.

1.2. Leeb Hardness Test (definition)

An impact body with a spherical test tip made of tungsten carbide is propelled against the sample surface by a spring force and then rebounds back. At a distance of 1mm from the sample surface, the impact and rebound velocity of the impact body are measured by the following method: A permanent magnet embedded in the impact body, when passing through the coil in its coil holder, induces in the coil an electric voltage proportional to the velocities of the magnet. Leeb hardness is expressed by the following formula:

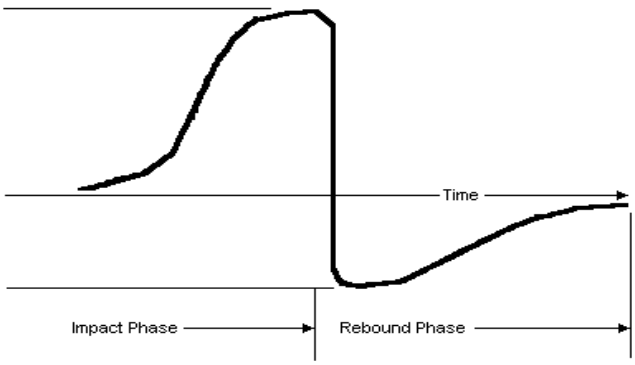
$HL=1000\times(V_B/V_A)$

Where: HL is Leeb Hardness

V_B is the rebound velocity of the impact body

V_A is the impact velocity of the impact body

The voltage characteristic of output signal, when the impact body passes through the induction coil is illustrated in the following figure:



Voltage characteristic of output signal

A Leeb's Hardness Tester measures the hardness of sample material in terms of Hardness Leeb (HL), which can be converted into other Hardness units (Rockwell B and C, Vicker, Brinell and Shore D).

1.3. Notation of Leeb Hardness

When measuring the hardness of a sample material using the traditional static hardness testing method, a change of applied pressure will result in a change in the hardness reading.

For example: 720HLD≠720HLC
Because different converting curves are obtained from different impact devices, when converting hardness L into another hardness value the notation for the converted hardness value should include the impact device used.

2. Features and Applications

2.1. Specifications

- ✓ Display: LCD
- ✓ Accuracy: +/-3HL at HL=800 (0.4%)
- ✓ Measuring range: 170-960HL
- ✓ Conversion: HL-HRC-HRB-HB-HV-HS-HRA-σb
- ✓ Materials: 9 different common materials
- ✓ Memory: 99 data can be stored and re-readable
- ✓ Impact device: D
- ✓ Power on/off: Auto
- ✓ Power supply: DC 9V Ni-MH rechargeable battery
- ✓ Dimension: 100×60×33mm
- ✓ Weight: 150g

2.2. Features

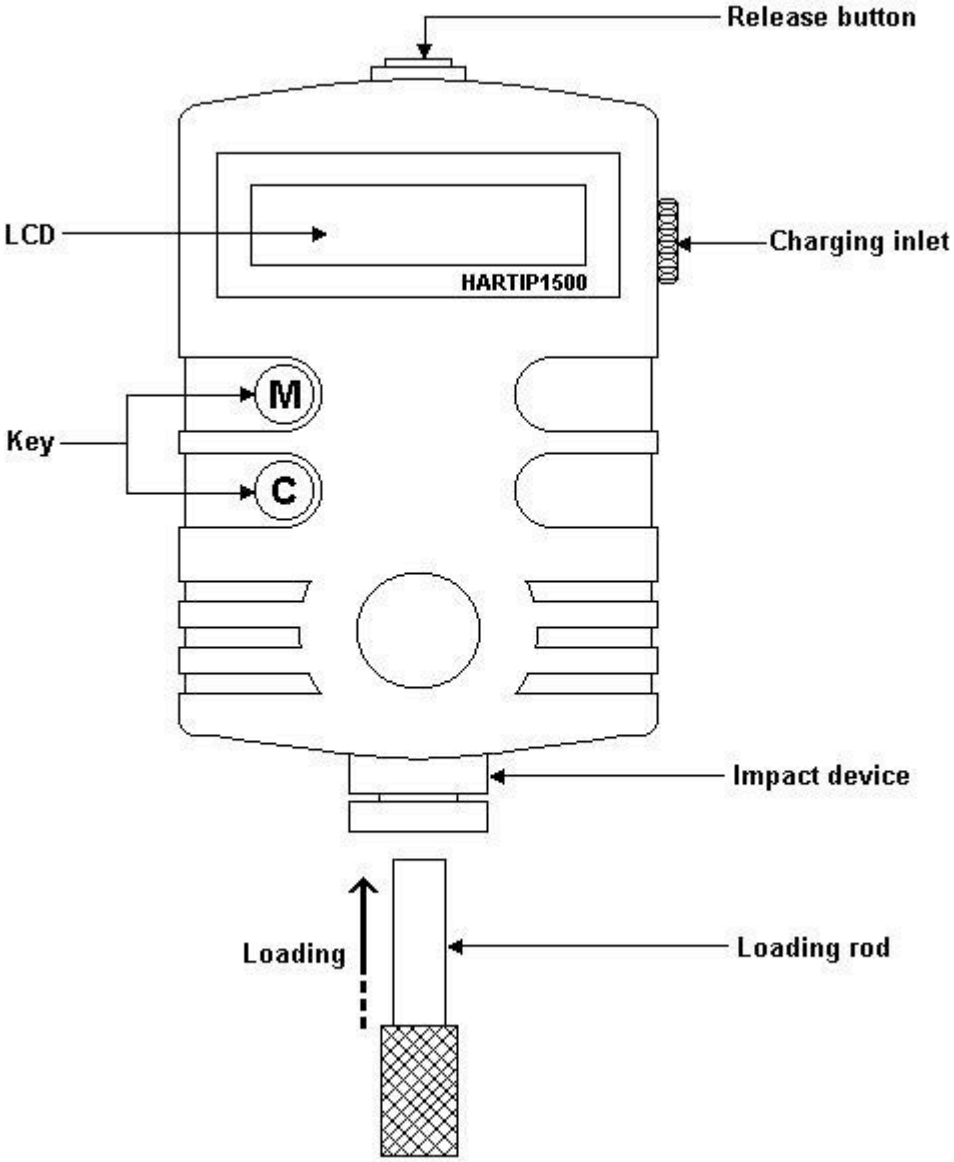
- ✓ Rugged and modular design
- ✓ Palm size for narrow space
- ✓ High accuracy
- ✓ Automatic power on/off
- ✓ Recalibration allowed

2.3. Applications

✓ Hardness tests on installed machines or steel structures: e.g. on heavy and large work-piece or on permanently installed system parts.
✓ Rapid testing of multiple measuring areas for examination of hardness variations over larger regions.

- ✓ Measuring hardness for produced parts at production line.
- ✓ Identifying metallic material stored in a warehouse.
- ✓ Ineffectiveness analysis of permanent parts, pressure -vessel, turbo generator.

3. Designation of Individual Parts



Key **M**

- Manu
- Calculate data (AVE, MAX, MIN)
- Increment when adjusting

Key **C**

- Change setting
- Delete unrealistic values
- Decrement when adjusting
- Read stored data

4. Symbols and Illustrations

4.1. Symbols and Illustrations

Symbols	Illustrations
LD	Leeb hardness value used with impact device D
HB	Brinell hardness value
HRB	Rockwell B hardness value
HRC	Rockwell C hardness value
HSD	Shore hardness value
HV	Vicker hardness value

4.2. Measurement and Conversion Table

Range for measurement and conversion:

IMPACT DEVICE D			HLD: 170-960		
	H R C	H R B	H B	H V	H S D
STEEL	20.0-67.9	59.6-99.5	80-647	80-940	32.5-99.5
CWT.ST	20.5-67.1			80-898	
ST.STEEL	19.6-62.4	46.5-101.7	85-655	85-802	
GC. IRON			93-334		
NC.IRON			131-387		
C.ALUM			30-159		
BRASS		13.5-95.3	40-173		
BRONZE			60-290		
COPPER			45-315		

5. Preparation before Measuring

5.1. Requirements for the sample

5.1.1. The surface temperature of sample should be less than 120 °C.

5.1.2. The samples must feature a metallic smooth, ground surface, in order to eliminate erroneous measurements brought about by coarse grinding or lathe scoring. The roughness of the finished surface should not exceed 2µm.

5.2. Requirements for the weight of the sample

For samples weighing over 5 kg and of compact shape, no support is needed.
Samples weighing between 2-5 kg, and also for heavier samples with protruding parts or thin walls, should be placed on a solid support in such a manner that they do not bend or move by the impact force.
Samples weighing less than 2 kg should be firmly coupled with a stable support weighing over 5 kg.

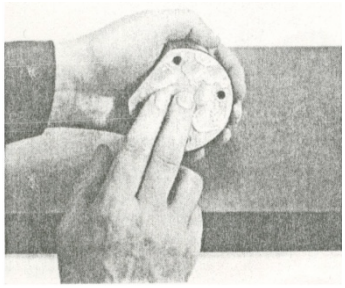
For coupling purposes,

- ✓ The coupling surface between the sample and base plate should be flat, plane parallel and ground.
- ✓ A thin proper layer of coupling paste is to be applied to the contact surface of the sample.
- ✓ The sample should be firmly pressed against the surface of the base plate by moving it with a circular motion.
- ✓ The direction of impact should be perpendicular to the coupling surface.
- ✓

For the coupling operation, the following prerequisites must be fulfilled:

- ✓ The contact surface of the sample and the surface of the base plate must be flat, plane parallel and ground.
- ✓ The direction of the test impact must be perpendicular to the coupled surface.
- ✓ Minimum thickness of the sample for coupling (5mm).

Proper Coupling:
Proper coupling requires a little experience. Insufficiently coupled samples produce large variations of individual measurements, L-values which are too low and the operation is characterized by a rattling noise upon impact of the test tip.
Example for coupling a test piece with a base plate:



Application of the coupling paste (As thin as possible).

5.3. Requirement for the surface hardened layer of the sample

Surface -hardened steels and especially case-hardened steels produce L-values which are too low when case-hardening depth is small because of their soft core. When measuring with impact device D the depth of the hardened layer should be no less than 0.8 mm.

5.4. Surface of the test sample should not be magnetic.

5.5. For test sample of curving surface with radius of curvature R less than 30mm, a small support ring should be used.

5.6. Supporting the Samples during Testing

Type of impact device	Classification of samples		
	heavy	medium-weight	light-weight
D	more than 5kg	2 - 5kg	0.05 - 2kg

When measuring hardness with HardyTest D100, the following has to be noticed: Despite the low mass of the impact body and low impact energy, a relatively large impact force of short duration is generated when the impact body hits the measuring surface. The max. impact force of impact device D is 900N.

For heavy samples of compact shape, no particular precautions are necessary.
Smaller and lighter samples or work pieces yield or flex under this force, producing L-values which are too small and of excessively large variation. Even with big or heavy work pieces it is possible for thin-wall regions or thinner protruding parts to yield upon impact. Depending on the frequency of the resilient yielding action, the
measured L-value may be too small or too large. In many situations, potential problems can be checked in the following manner:
a) Medium-weight samples and also heavier samples with protruding parts or thin walls should be placed on a solid support in such a manner that they do not move or flex during the test impact.
b) Light-weight samples should be rigidly “coupled” with a non-yielding

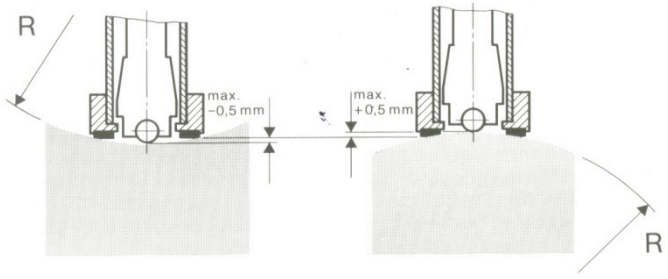
support such as a heavy base plate. Clamping in a vice is of no value, since the samples become exposed to stress and because complete rigidity is never attained. As a rule, the measured L-values would be too small and show excessive variations.

5.7. Samples with Curved Surfaces

Impact testers only work properly, if the impact body has a certain position in the guide tube at the moment of impacting the test surface. In the normal position, automatically present when testing flat and convex-cylindrical samples (such as round samples), the spherical test tip is located exactly at the end of the guide tube.

However, when testing spherically or cylindrically shaped concave surfaces, the impact body remains further within the guide tube or protrudes further therefore. Thus, with such types of curved surfaces, it is to be observed that radii of curvature do not drop below the values indicated in the following Fig.

Curved surfaces should always be tested with the small support ring.

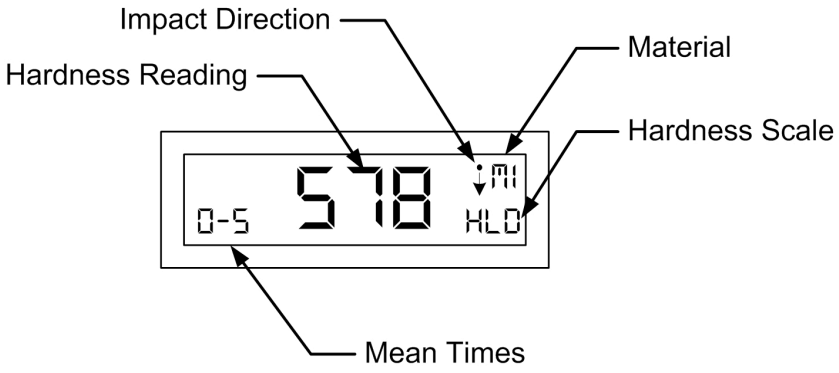


Impact device types D R_{min}=30mm

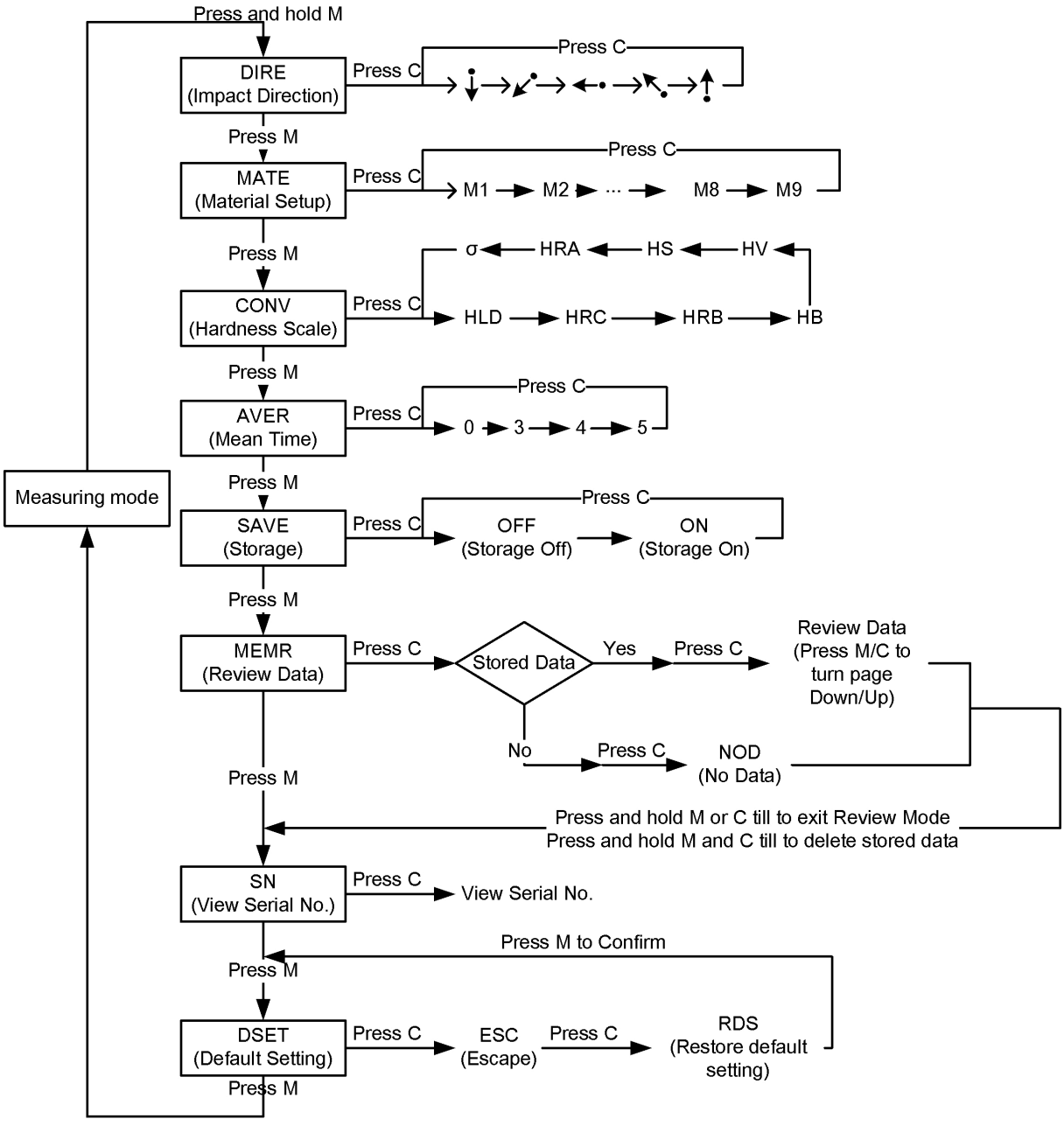
For impact devices D, special support rings are available to accommodate smaller radii on convex or concave surface.

6. Operation

6.1. LCD Display



6.2. Diagram of operation



6.3. Turn on the tester

Press release button (on the top of the tester) to turn on the tester. Then the tester will enter measuring mode.

6.4. Menu

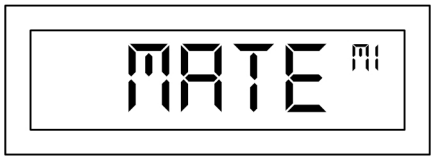
Press and hold key M till “MENU” flashes then enter “DIRE” item. By pressing key M in turn to enter into item MATE, CONV, AVER respectively. Finally come back to the mode of measurement.

6.4.1. Impact Directions

After pressing and hold key M to enter item DIRE, press C in turn to change the impact direction.

6.4.2. Materials

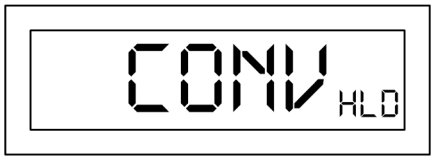
After pressing key M into item MATE, press C in turn to change the materials setting(M1-M2…-M9).



M1: Steel/Cast Steel
M2: Cold Work Tool Steel
M3: Stainless Steel
M4: Grey Cast Iron
M5: Cast Iron nod.
M6: Cast Alum. Alloys
M7: Brass
M8: Bronzes
M9: Wrought Copper All.

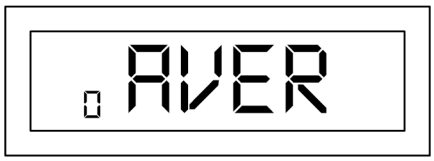
6.4.3. Hardness Scales

After pressing key M into item CONV, press C to change the hardness scale (HLD-HRC-HRB-HB-HV-HS-HRA-σb).



6.4.4. Average times

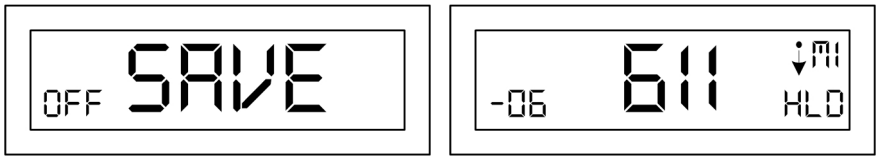
After pressing key M into item AVER, press C in turn to select the average times from 0-3-4-5. Selecting 0 means no average values.



6.4.5. Memory

After pressing key M into item SAVE, press C in turn to switch between On and Off. Selecting On means memory is activated. The HardyTest D100 can save 99 values in its memory and these stored values can be read after work.

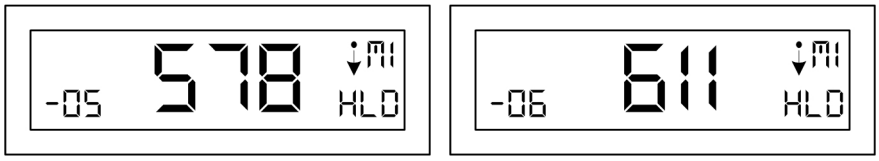
After memory is activated, -00 will be displayed on down-left corner of LCD while measuring. Take measurements, all values will be stored automatically in memory.



6.4.6. Review Stored Data / Delete Stored Data

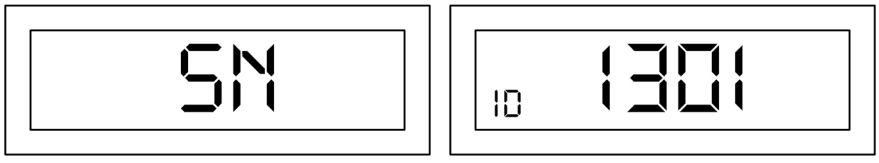
After pressing key M into item MEMR, press C to read stored data. At the same time, press key M or C to recall stored values forwards and backwards. If no data is stored, NOD is displayed on LCD.

Press and hold key M or C to exit data review mode. Press and hold key M and C simultaneously to delete stored data.



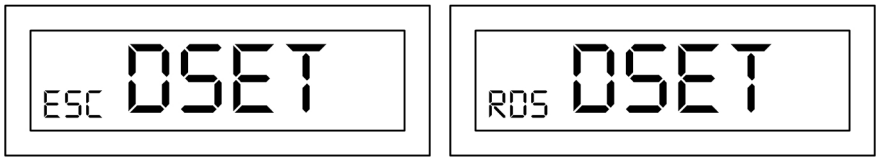
6.4.7. Check Serial Number

After pressing key M into item SN, press C, the serial number will display on LCD. Press M to enter next item.



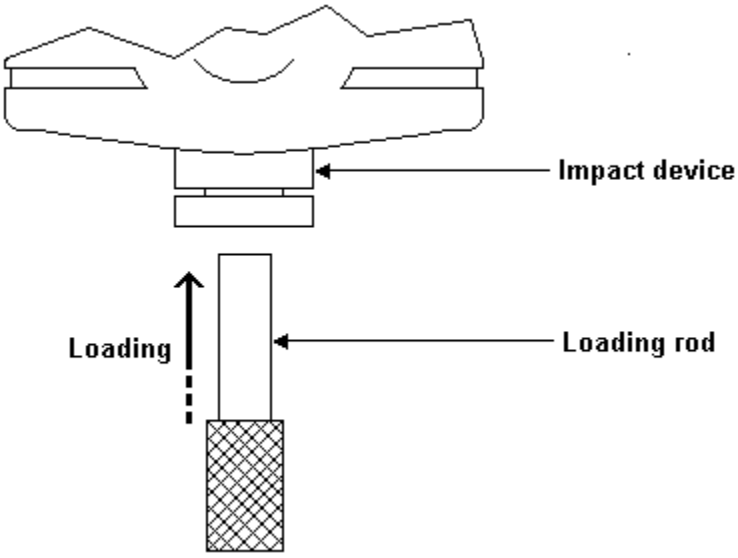
6.4.8. Restore Default Settings

After pressing key M into item DSET, press C to switch between ESC and RDS. ESC means Escape, RDS means restore default settings. Press M to confirm.



6.4.9. Press key M to get back to the measuring mode, then LCD displays 000.

6.5. Take Measurement



1) Press the release button on top of the HardyTest D100 to turn on the tester.
2) Insert the loading rod into the tube of the impact device to push the impact body to depress the spring until the impact body is locked.
3) Place the tester against the surface of the work piece
   Please note: the impact device must be firmly against the surface or you may get unsatisfied value.
4) Press the release button on top of the tester and take measurement. The measuring value will be displayed on LCD.

6.6. View Statistic Value

After testing certain times, press M in turn. The LCD displays the mean value, max value and min value.

Please note: If a value is not realistic during measuring, press key C to delete it on LCD in order to not influence the calculation of average.

7. Calibration

After a long period of usage, especially for measuring harder materials, the ball tip of the impact body will be worn which may lead to less accuracy.

At this point, recalibration is necessary.

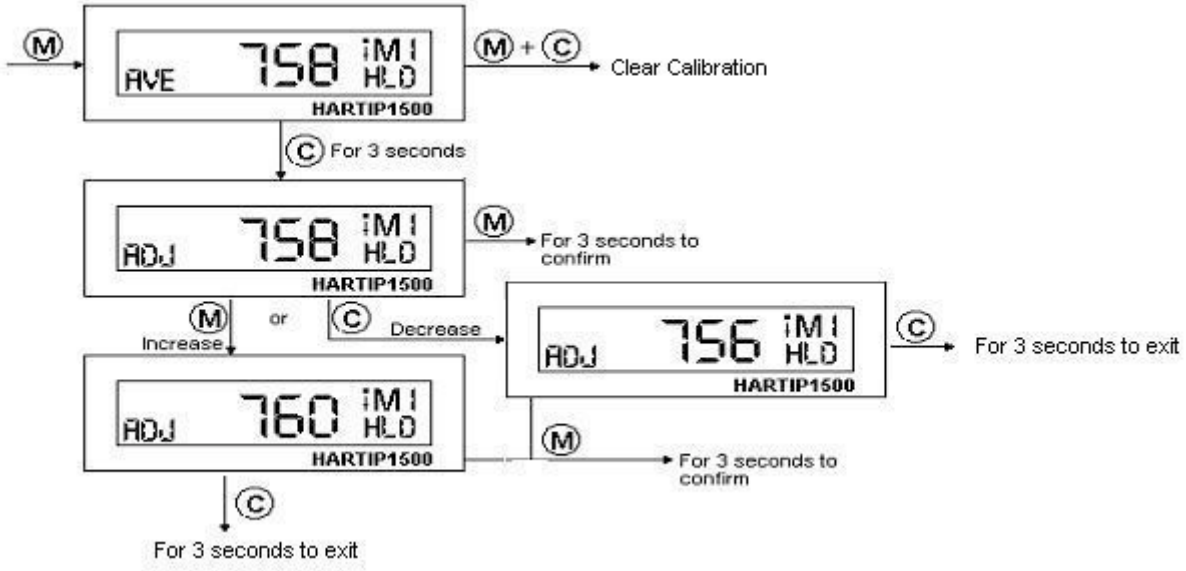
7.1. Calibration Procedure

7.1.1. Calibration is available in HLD scale only.

7.1.2. Make sure the average time is to be set up to 3 times.

7.1.3. Take measurements on standard test block 3 times.

7.1.4. Press key M to display the average value of measurements.



7.1.5. Press and hold key C to enter the mode of calibration. ADj will be displayed at left side of the LCD.

7.1.6. Press key M or C to increase or decrease the standard value.

7.1.7. Press and hold key M to finish the calibration.

7.1.8. Press and hold key C to quit the calibration procedure without saving.

Please note:

1. If the measurement error comes within the range of accuracy, please do not make any calibrations.
2. When the impact body is replaced, please make sure to clear Calibration (compensation value) first.

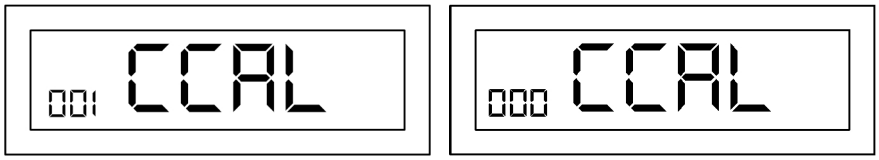
7.2. Clear Calibration (Compensation value)

After a long period of usage, you may have to replace the impact body with a new one. Thus it is needed to clear compensation.

7.2.1. Set up average to 3 times and take any measurements accordingly.

7.2.2. Press key M to display the mean value.

7.2.3. Press and hold key M and C simultaneously to enter CCAL mode. 001 means one calibration was done before.



7.2.4. Press C to clear previous calibration. An “OK” and 000 CCAL displays, which means the calibration value was cleared.

7.2.5. Press C or M to go back to measuring mode.

8. Maintenance and Repair

Do your best to avoid shock, heavy dust, damp, strong magnetic field, and oil stain.

8.1. Maintenance of the Impact Device

The devices do not require any particular care other than periodic cleaning of the impact body and the guide tube after performing approximately 1000-2000 tests. During cleaning, the following procedures need to be observed:

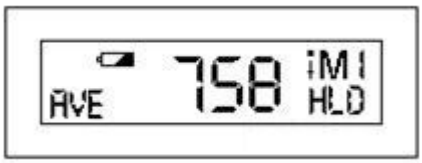
Unscrew support ring and remove impact body from guide tube.

Clean off any dirt and metallic dust from the impact body and the spherical test tip.

Clean guide tube with the special brush provided.

Do not apply oil to any parts for the impact device.

8.2. Charging Battery



When the battery indicator displays it is nessesary to charge the battery. However, it is still possible to measure for some time. **Please make sure to obtain additional or replacing battery from the manufacturer**. Insert the plug of the battery charger into the socket on the right side of the tester. Connect the battery charger with an energy source. It may take 12-15 hours to fully charge the battery.

8.3. Fault Diagnosis

If finding any abnormalities, please read our fault diagnosis first.

8.3.1. No impact occurs-impact body is not or improperly located in the impact device/impact body does not release or cannot be loaded.

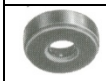
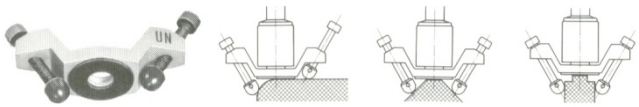
8.3.2. Marked deviation of individual L-values or L-values constantly too low-measuring area inadequately prepared/the tested material is extremely inhomogeneous or porous/sample is insufficiently supported/sample exhibits large local hardness differences e.g. at the transition seam to the base material/impact direction has been change between the individual impacts.

8.3.3. L-values at the standard test block constantly too low-impact device contaminated/spherical test tip cracked (e.g. due to impact against tungsten carbide)/support ring does not have rubber pad.

8.3.4. L-values at the standard test block constantly too high-spherical test tip flattened (impact against tungsten carbide, wear)/standard test block damaged or full of indentations.

8.3.5. If ERROR displays on the LCD, it means you make an improper operation.

9. Optional Accessories

Support Rings for Impact Device D			
Part designation and dimensions:			Suitable for the following surfaces
 D6	Φ 19.5×5.5mm	R≥60mm	plane cylindrical hollow-cylindrical spherical hollow-spherical
 D6a	Φ 13.5×5.5mm	R≥30mm	plane cylindrical hollow -cylindrical spherical hollow-spherical
Special Support Rings			
			Cylindrical
Z 10-15	20×20×7.5mm	R 10mm-15mm	R<10mm not possible R≥30mm D6/D6a
Z 14.5-30	20×20×6.5mm	R 14.5mm-30mm	
Z 25-50	20×20×6.5mm	R 25mm-50mm	
			hollow-cylindrical
HZ 11-13	20×18×5mm	R 11mm-13mm	R<11mm not possible R≥30mm D6a
HZ 12.5-17	20×20×5mm	R 12.5mm-17mm	
HZ 16.5-30	20×20×5mm	R 16.5mm-30mm	
			spherical
K 10-15	Φ 20×7.7mm	R 10mm-13mm	R<10mm not possible R≥30mm D6/D6a
K 14.5-30	Φ 20×6.7mm	R 14.5mm-30mm	
			hollow-spherical
HK 11-13	Φ 17×5mm	R 11mm-13mm	R<11mm not possible R≥30mm D6a
HK 12.5-17	Φ 18×5mm	R 12.5mm-17mm	
HK 16.5-30	Φ 20×5mm	R 16.5mm-30mm	
UN	Φ 52×20×16mm		
			

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