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Instruction Manual
HMO

HMO LEEB IMPACT HARDNESS TESTER

Table of contents

Caution

Please carefully read this first:

1. Only the special battery and provided power adapter may be used for the hardness tester. Otherwise it may cause damages to the product i.e. battery leakage, even fire or explosions.

2. Any components of the hardness tester may not be submerged into water or exposed to rain which could cause a battery explosion and the instrument might be damaged.

3. To avoid electrical shocks, the housing may not be opened.

4. If the instrument isn’t used for a longer period, it has to be stored in a cool and dry place after fully charging it once a year. This serves to maintain the battery functions.

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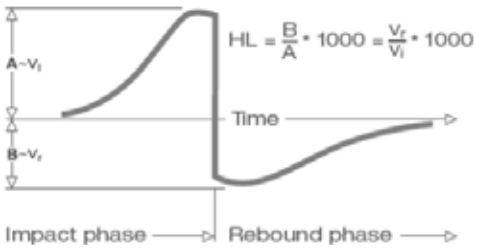
1. Summarize

1.1 Measuring principle scope



The measuring principle of HMO Hardness Tester is physically a rather simple dynamic hardness test:
An impact body with a hard metal test tip is propelled by spring force against the surface of the test piece. Surface deformation takes place when the impact body hits the test surface, which results in a loss of kinetic energy. This energy loss is calculated by velocity measurements when the impact body is at a precise distance from the surface for both, the impact phase and the rebound phase, of the test. The permanent magnet in the impact body generates an induction voltage in the single coil of the impact device.
The voltage of the signal is proportional to the velocity of the impact body. A signal processing by the electronics provides the hardness reading for display and storage. Simply said, harder materials produce higher rebound velocities than less harder ones (higher L- value).
HMO Hardness Tester provides a direct hardness measurement within any particular material group (i.e. steel, aluminium etc.). It can be used as a final test result without conversion. However, there are established conversions to other hardness scales in this Hardness Tester as a comfort for our customers. These conversions to other scales (HRC, HRB, HB, HV, HSD etc.) are programmed into the electronics and they can be shown directly on the display as a test result. All data is stored in the native L scale to prevent any possible errors with multiple conversions.

1.2. The Hardness value “L”

This term was introduced 1978 into measuring technology by Dr. Dietmar Leeb. It contains the quotient for the impact body’s rebound and impact velocity, multiplied by 1000. Harder materials produce higher rebound velocity than less harder ones. With reference to a particular material group (i.e. steel, aluminium etc.), the L value represents a direct hardness measurement and is used as such. Comparison curves with other standard statistic hardness values have been established (Brinell, Vickers, Rockwell C, B) for the most prevalent materials, enabling the
L values to be converted into the relevant values by these procedures. With this hardness tester, such hardness values can directly be displayed in the hardness scales HRC, HRB, HB, HV, HSD and tensile strength (MPa).

1.3 Main features

- Highly accurate, ± 6 HL
- Automatic correction for impact direction
- Large, easy to read display with backlight
- English, German, French, Italian, Spanish, Russian, Chinese simplified, Chinese traditional
- User profiles for fast change of all settings
- Operation with Touch Screen
- Large memory with on- screen review of data
- Conversion to all common hardness scales HRC, HRB, HB, HV, HSD and tensile strength (MPa).
- Rechargeable Li- ion batteries
- Conforms to the standards DIN 51056 and ASTM A 956-02.

1.4 Application range

- Appropriate for all metals
- Ideal for production level testing
- Best suited for on- site testing of heavy, big or already installed parts
- Handy for difficult to access or confined test locations
- Automatic compensation for impact direction
- Excellent for material selection and acceptance tests
- Easy to handle and accurate on curved test surfaces (R> 10mm)
- Metal production & processing
- Automotive & transportation
- Aerospace & shipyard
- Testing services & laboratories

1.5 Technical information

1.5.1 Display unit

- HL Display Range: 0 ~ 1000 HL
- Accuracy: ± 6 HL
- Display of the main body: large LCD with adjustable contrast, backlight, Touch Screen
- Unit Material: shock resistant ABS plastic
- Internal Data Storage : ~ 800 measured values
- Resolution: 1 HL; 1 HV; 1 HB; 0,1 HRC; 0,1HRB; 1 HSD; 1 MPa
- Battery type: rechargeable Li- Ion
- Operating temperature: 0°C up to + 50°C (32°F up to 122°F)
- Storage Temperature: -10°C up to + 60°C (14°F up to 140°F)
- Humidity: 90 % max.
- Dimension: 135 x 83 x 24mm (5.3 x 3.2 x 0.9 inches)
- Weight: 228 g

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1.5.2 Impact Devices

The HMO is fitted with the universal impact device D. Special impact devices are available for usage in extremely confined spaces with special components of geometry or surface finish. These additional types significantly extend the possibilities of application from HMO. Each special impact device is compatible with unit D indicating device and is supplied as accessory.

1.5.2.1 Impact device D

Application : For the majority of your hardness testing assignments.
Impact weight: 75 g
Impact energy: 11 Nmm
Mass of the impact body: 5.5 g
Test tip diameter: 3 mm
Test tip material: tungsten carbide
Test tip hardness: ≥ 1600 HV

1.5.2.2 Impact device DC

Application: Used in very confined spaces, e.g. in holes, cylinders or for internal measurements on assembled machines.
Weight: 50 g

1.5.2.3 Impact device DL

Application: For measurements in extremely confined spaces or at the base of grooves.

Weight: 100 g

1.5.2.4 Impact device C

Application: Surface of hardened components, coatings, thin walled or impact sensitive components (small measuring indentation).
Weight: 75 g

1.5.2.5 Impact device D+15

Application: Particularly slim front section and with measuring coil moved back. Suited for hardness measurements in grooves and on recessed surfaces.
Weight: 80 g

1.5.2.6 Impact device G

Application : Heavy castings and forging solid parts.
Weight : 250 g

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Preparation of the surface	Impact devices D, DC, DL, D+15	C	G
Roughness class ISO	N7	N5	N9
Max. roughness depth Rt	10 µm	2.5 µm	30 µm
Centre line average CLA, AA, Ra	2 µm	0.4 µm	7 µm
Min. weight of samples			
of compact shape	5 kg	1.5 kg	15 kg
on solid support	2 kg	0.5 kg	5 kg
coupled on plate	0.1 kg	0.02 kg	0.5 kg
Min. thickness of sample			
uncoupled	25 mm	15 mm	70 mm
coupled	3 mm	1 mm	10 mm
surface layer thickness	0.8 mm	0.2 mm	

Max. hardness of samples			
Indentation size on test surface			
with 300 HV, 30 HRC *			
diameter	0.54 mm	0.38 mm	1.03 mm
depth	24 µm	12 µm	53 µm
with 600 HV, 55 HRC *			
diameter	0.45 mm	0.32 mm	0.90 mm
depth	17µm	8 µm	41 µm
with 800 HV, 63 HRC *			
diameter	0.35mm	0.30 mm	
depth	10µm	7 µm	

*** Approximate hardness conversion for steel**

1.5.2.7 Support rings

On curved surfaces having a radius less than 30 mm, effective positioning on the test object is facilitated by the use of support rings (set of 12 pcs.). The appropriate support ring has to be screwed onto the front of the impact device. The set includes cylindrical, hollow-cylindrical, spherical or hollow-spherical surfaces with a radius of 11 mm. Special support rings can be manufactured for geometrically complex surfaces.

1.5.2.8 Application criteria

The support rings are valid for impact devices D,DC, DL, C, D+15, G. As standard practice for hardness measurements, the measuring location surface should be bright and smoothly. It does not have to be polished. Any damage to the test piece surface will be minimal by testing with the HMO. At least, 2 or 3 test impacts should be performed at each measuring location and then, in all cases, the average should determine for the individual readings. A surface of 10 x 10 mm is sufficient for measurement purposes. The device can also be used without special preparation using the impact device D. Slim work pieces and those weighing between 2 and 5 kg must be placed on a solid base plate for testing in the way that the force of the impact neither shifts them nor causes them no flex, as otherwise the readings could be falsified. Compact miniature parts with plane measuring surfaces can also be tested, but they have to be “coupled” for the purpose with a rigid base. “Coupling” is arranged by lightly coating the test object with coupling gel and sticking it firmly to a base plate of adequate weight.

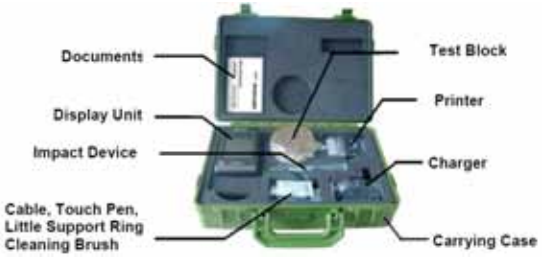
1.6 Overview the Display unit

Fig 1.1

1. Sensor jack
2. LCD screen
3. Printer and charger jack
4. Reset hole
5. IrDA window

2. Checking supplied accessories

It should be checked that the following accessories are supplied with your instrument (Fig. 2.1):



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3. Quick start guide

3.1 Connection

The signal cable is used to connect the impact sensor and the display unit.
Picture 3-1

3.2 Charge the battery

The battery (in the display unit) has to be charged before the first use of the Impact Hardness Tester.

3.3 Calibration

The test block has been calibrated in accordance with the dynamic hardness value L. The HMO Impact Hardness Tester has to be calibrated by the test block before the first use (see item 4.2.5.1).

4. Operating instructions

4.1 Display unit

4.1.1 Keyboard description

The Power on/off button has to be pressed to turn on the instrument. In any case, this button can be pressed again for one second to turn it off.
Note: During the instrument is charging, to monitor the charging state, the instrument cannot be turned off by pressing this button!

4.1.2 Measuring mode

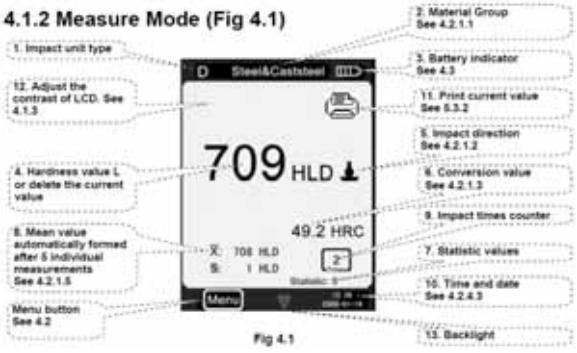

Fig 4.1

1. Impact unit type
2. Material group
3. Battery remaining indicator
4. Hardness value L
5. Impact direction
6. Conversion value

Note: When "---" appears at this position, it is indicated that conversion is out of range.
When there is no message at this position, this indicates that the "Scale" is being set and that there is no conversion in this time.

7. Statistic values
8. Statistic times value: The impact times in a statistic data group
9. Impact times counter
10. Time and date
11. Print current value
12. Adjustment of the contrast of LCD
13. Backlight on/off: it has to be clicked and the backlight will turn on if it is turned off; if it is turned on, it has to be clicked to turn it off.

4.1.3 Adjusting the LCD contrast manually

Due to the use of different ambient temperatures and light conditions, it is necessary to adjust the contrast of the LCD for a better observing and reading of data.
If "A" area is clicked, the dialog box which adjusts the contrast of the LCD, can be opened (see picture 4-2).
Then it has to be clicked directly to "Contrast Adjustment" and the contrast can be adjusted on the touch screen.
After this is achieved, "A" area has to be clicked to confirm the contrast and to close this dialog box.
If there is no operation within 3 seconds during the dialog box is opened, it will close automatically. After adjusting the contrast, it will be stored to its original state as long as "A" area isn't clicked again for the next current operation.
Fig. 4-2

4.1.4 Select the Type of Impact Device

It has to be clicked on the icon "D" in the upper left corner of Fig. 4-1 to change the type of impact unit. D Type impact unit, G Type impact unit. If other types are needed, please contact us.
Note: 1. Make sure that the correct type of impact device has been chosen, otherwise the test value will be incorrect.
2. This operation is only valid in the main interface.

4.2 Using the Menu

HMO Impact Hardness Tester selects the Multistage Menu Mode, as shown in picture 4-3. In Measuring Mode, MENU has to be clicked on the screen to display the menu (Fig.

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4.4).

Figure 4-3

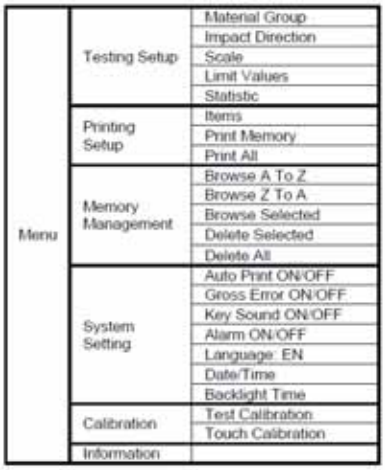


Figure 4-4

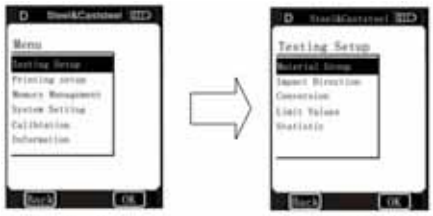
Measure mode Menu mode

Picture 4-4 contains six options:

Testing Setup, Printing Setup, Memory Management, System Setting, Calibration and Information.

4.2.1 Testing Setup

Picture 4-5



Menu mode Testing setup menu

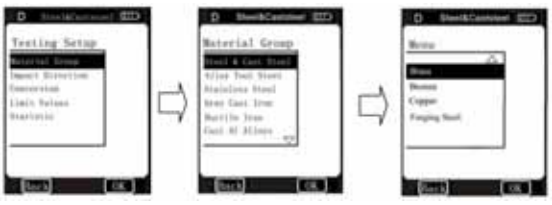
Testing Setup item has to be clicked in Menu Mode to display the Testing Setup Menu.

This Menu contains five selectable items:

Material Group, Impact Direction, Conversion, Limit Values and Statistic.

4.2.1.1 Material group

Picture 4-6



Picture 4-7

In Measuring Mode, the touch pen has to be used to click the “Material Group” to select the desired material.

When the type of impact unit is set to D and “Scale” is set to hardness scale (see picture 4-6) and it is clicked on “Material Group” continuously, the material changes according to following sequence:

Steel & Cast Steel→ Alloy Tool Steel→ Stainless Steel→ Grey Cast Iron→ Ductile Iron→ Cast Alloys→ Brass →Bronze→ Copper→ Forging Steel→ Steel & Cast Steel..

When the type of impact unit is set to D and “Scale” is set to MPa (tensile strength), (see picture 4-7) and if it is clicked on “Material Group”

Low Carbon Steel→ Hi Carbon Steel→ Chrome Steel→ Cr-V Steel→ Cr-Ni Steel→ Cr- Mo Steel→Cr-Ni-Mo Steel→ Cr-Mn-Mo Steel→ Cr-Mn-Si Steel→ Hi Strength Steel→ Stainless Steel→ Low Carbon Steel…

When the type of impact unit is set to G and if it is clicked on “Material Group” continuously, the material changes according to following sequence:

Steel & Cast steel→Alloy Tool Steel→Stainless Steel→Grey Cast Iron→Ductile Iron→Steel & Cast steel→…

Note: When the type of impact unit is set to G, the Scale can only be set to HV or HRB.

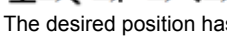
It has to be clicked onto the desired material with the touch pen to select the material. With “△”or “▽”it has to be scrolled up and down. To get to the upper menu, it has to be clicked “Back”.

Note: 1. It is necessary to select the material classification. If the type of material isn’t known, the handbook will provide assistance.

2. If the material group has been changed, the impact times counter will be set to “0”.

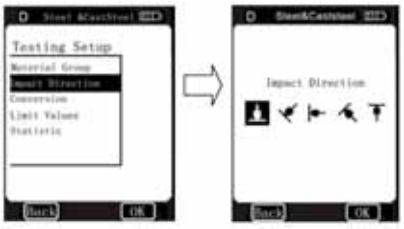
4.2.1.2 Impact direction

In measurement mode, the touch pen is used to click to “Impact direction” logo to set the desired impact direction. If it is clicked continuously on that logo, the impact direction changes according to following sequence:



The desired position has to be chosen and clicked.

Picture 4-8



Testing Setup menu Impact direction

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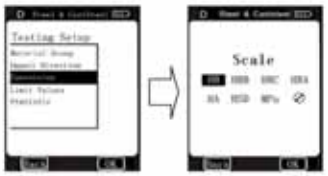
4.2.1.3 Scale

In measurement mode, the touch pen has to used to click on “Scale” logo to select the desired hardness scale or tensile strength. With the selected D Type impact unit, “Scale” has to be clicked continuously and the scale changes according to following sequence:

Picture 4-9

HB→HRB→HRC→HRA
→HV→HSD→MPa→HB
...

HB	Brinell
HRB	Rockwell
HRC	Rockwell
HRA	Rockwell
HV	Vickers
MPa	Tensile strength



Testing setup menu Scale menu
Fig 4.9

With the selection of the G Type impact unit, “Scale” has to be clicked continuously and the scale changes according to following sequence: **HB→HRB→HB...**

In Scale Menu, the desired hardness scale or tensile strength has to be clicked to select the hardness scale or tensile strength.

In picture 4.9, the impact unit is set to D.

In picture 4.10 (see below), the impact unit is set to G.

Picture 4-10

Note: 1. Since there are differences between the different hardness scale’s valid range, some HL test value cannot be converted. In this case, the “---“ will be shown at the place where the conversion value normally is displayed.

2. If the scale is set from hardness scale to tensile strength or the other way round, the material group has to be reset.

3. The conversion value only supplies the general reference, which results in some offset. Generally, comparative tests are necessary to achieve precise conversion.

4.2.1.4 Limit values

When the measured value “L” is out of the limit value range, the display unit will alarm and send out a prompt.

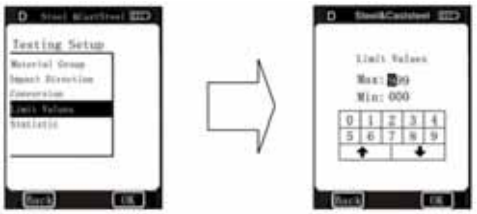
In Testing Setup Menu, Limit Values item has to be clicked to display the Limit Values Setup Menu. The Limit Values have to be set by a click on the screen control panel.

OK has to be clicked to confirm the Limit Values Setup.

Click back to cancel the Limit Values Setup.

Click ⬆⬇to select a desired bit.

Picture 4-11



Testing setup menu Limit values setup menu

4.2.1.5 Statistics

HMO Impact Hardness Tester has got an automatic statistic function. If the impact times are up to the Statistic Times Value, “$\overline{X}$”value (the mean value of the measured hardness value L) and „S“ value (the difference of the max. value and the min. value) are automatically formed and displayed on the screen. In Measurement Mode, “Statistic “ item has to be clicked with the touch pen to display the Statistic Times Value setup menu; or in Testing Setup Menu, “Statistic “ item has to be clicked to display the Statistic Times Value setup menu (see picture 4-12).

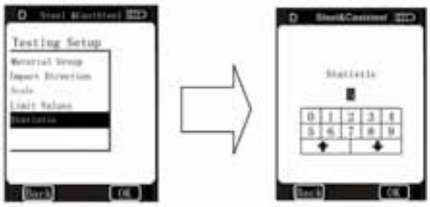
The Statistic Times Value has to be set by a click on the screen and then OK has to be clicked.

Click OK again to confirm the Statistic Times Value entry.

Click BACK to cancel the procedure.

Click ⬆⬇ to increase or decrease the Statistic Times Value.

Picture 4-12



Testing setup menu Statistic times value setup menu
Fig 4.12

Note: 1. The Statistic Times Value range is 1~99. If this value is set to 1, the system has got no Statistic process.

2. When this value has been reset, the impact times’ counter will start counting from “0”.

4.2.2 Printing Setup

With the Micro- printer it is possible to print out the measured values in many formats. In Menu Mode, Printing Setup has to be clicked to display the Printing Setup Menu (see picture 4-13). There are three options in this menu: Items, Print Memory and Print All.

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4.2.2.1 Items

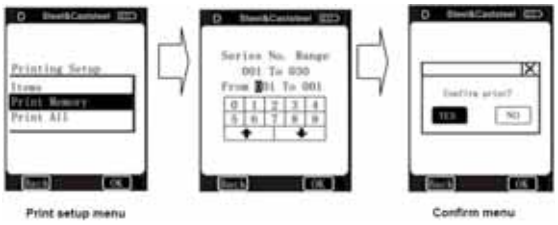
A complete test result report should include: measured values, conversion values, date, time, impact direction, statistic value, material etc. The printing items can be chosen in this menu. There are five options in this menu:
Date, Time, Direction, Mean Value and Material (see 4-13)
In Items Menu, the desired item has to be clicked to display its Function Switch.
"ON" or "OFF" has to be clicked to confirm the choice.
"BACK" or "X" has to be clicked to return to the upper menu.

Picture 4-13

4.2.2.2 Print Memory

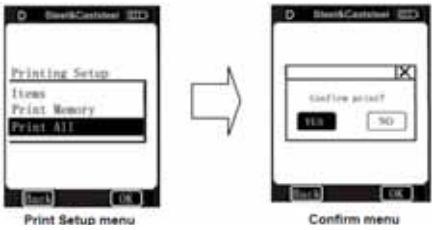
The measured values and related items can be printed by means of this menu. In Printing Setup Menu, Print Memory item has to be clicked with the touch pen to display the Serial No. Range menu (see picture 4-14).
The printing range has to be set by a click on the screen control panel (click ⬆⬇ to select a desired bit). Then OK has to be clicked to display the Confirm Menu.
Click "YES" to confirm printing or "NO" to cancel printing.
"BACK" or "X" has to be clicked to return to the upper menu.

Picture 4-14



4.2.2.3 Print all

With this menu, all the measured data in memory can be printed by the following steps:
In Printing Setup Menu, the touch pen has to be clicked on Print All item to display the Confirm Menu,
see picture 4-15 below.
Picture 4-15

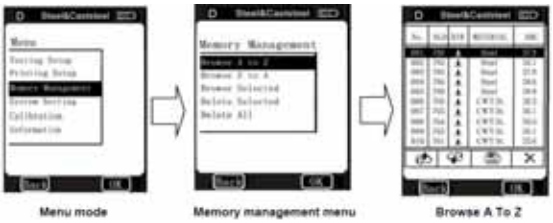


The touch pen is used to click "YES" to confirm printing or with "NO" printing will be cancelled. With "BACK" or "X" printing is cancelled and it is returned back to the upper menu.

Note: HMP Impact Hardness tester can save about 800 data in memory. It will take a very long time to print out all data in memory.

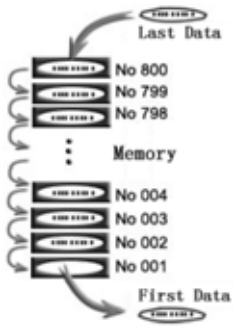
4.2.3 Memory management

In this menu, it is possible to browse and delete the memory data, simultaneously the memory data can also be printed out.
In Menu Mode, Memory Management item has to be clicked to display Memory Management Menu (see 4-16).
There are five options in this menu:
Browse A to Z, Browse Z to A, Browse Selected, Delete Selected and Delete All.
Picture 4-16



4.2.3.1 The Format of Memory data

The data group, such as test result, conversion result, sample material and impact direction, are automatically saved in memory after each measurement. The format of memory data is shown in picture 4-17:



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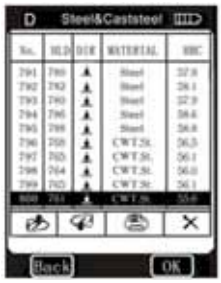
4.2.3.2 Data Browser mode

This tester includes three browser modes: Browse A to Z, Browse Z to A and Browse Selected.
It has to be clicked directly onto Memory Management Menu to display the relevant Data Browse Menu. If "Browse A to Z" item is selected, the menu is shown in picture 4-16.

In this menu it has to be clicked to page up, to page down, to delete a selected group of data. It has to be clicked to print a selected group of data.
By clicking **OK** the test time of a selected group of data will be demonstrated. If "Browse Z to A" item has been selected, the menu is shown in picture 4-18.



It has to be clicked to page up and to page down, to delete a selected group of data. It has to be clicked to print a selected group of data. By clicking **OK** the test time of a selected group of data will be demonstrated.
If Browse Selected item is desired, the serial No. range of the group of data stored in memory can be selected. This menu is shown in picture 4-19. In this menu, the input method is the same as in Print Memory, please refer to 4.2.2.2. If the serial No. input is finished, OK has to be clicked to browse the selected group of data (see 4-20).

It has to be clicked to page up and to page down, to delete a selected group of data. It has to be clicked to print a selected group of data. By clicking **OK** the test time of a selected group of data will be demonstrated.

Picture 4-19

Picture 4-20

4.2.3.3 Delete Memory Data

There are three ways to delete memory data:
1. Delete Memory Data in Data Browser Menu, please refer to 4.2.3.2.

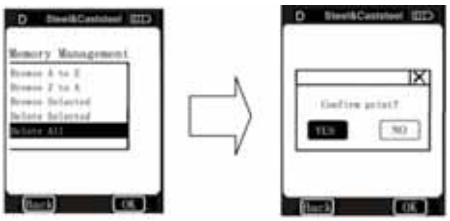
2. Delete Selected: In Memory Management menu, Delete Selected item has to be clicked to display the Serial No. Range menu (see 4-21).In Serial No. Range menu, the desired range to delete has to be input. Then **OK** has to be clicked on the screen to display the Confirm Menu. The touch pen is used to click "YES" or **OK** to confirm deletion or "NO" to cancel deletion. With "BACK" or "X" deletion is cancelled and returned back to the upper menu.

Picture 4-21

Memory management menu Serial No. range menu Confirm menu

Note: If the input range is out the Serial No. range, the actual data group will be deleted in the input range and in memory data sequence the number will be arranged.

Picture 4-22



3. Delete All: This operation will delete all data in memory. To do this, in Memory Management it has to be clicked onto Delete All item to display the Confirm Menu (see 4-21). Click "YES" or OK to confirm deletion.
Click "NO" to cancel deletion.
With "BACK" or "X" deletion is cancelled and returned back to the upper menu.

4.2.4 System setting

System setting contains some system function switches. Various switching functions can be setup according to the users' requirements, such as the adjustment of system calendar and clock.
In Menu Mode, System Setting item has to be clicked on the screen to display System Setting Menu. There it can be set for the corresponding switches to turn into the windows of system setting calendar and clock.
By clicking "BACK", it will be returned to the upper menu.

4.2.4.1 System function switch

Four functions can be setup on the System Setting Menu: Auto Print, Gross Error, Key Sound (Alarm), Language, Date/Time, Light Time.

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Picture 4-23

The function-setting window can be opened by pressing the button to choose relative operation options. This item has to be clicked to conduct function-setting (see 4-23).
It can be chosen to turn this function on or not. It has to be clicked directly ON or OFF to confirm the amendment.
Operation can be cancelled by clicking “BACK” or “X” on the screen.
If Auto Print is set at “ON”, the data will be printed automatically after the data measurement is finished.
If Gross Error is set at “ON”, gross errors will be shown according to Grubbs criteria as the Statistic Times Values have been completed, see picture below:

Picture 4-24

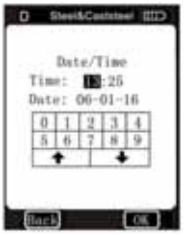
Deletion can be conducted by clicking ✕ (please refer to 4.2.3.3). When data have been deleted without supplementary measurements taken, it can be clicked OK to confirm the end of the measurement and be ready for the next one. If supplementary point’s measurement is needed, it has to be clicked BACK to get to the Measurement Mode window and then perform supplement.
When Key sound is set at “ON”, the buzzer will shortly beep once, if effective icons are clicked on the touch screen.
When Alarm is set at “ON”, the buzzer will continuously beep twice, if the measured value is out of the limit values or if a gross error appeared.

4.2.4.2 Language

In System Setting menu, Language item has to be clicked to display the Language Setup menu (see below, fig.4-25).

4.2.4.3 Date/ Time

IN System Setting Menu, it has to be clicked directly on Date/Time item to display the Date/Time setup menu.
Picture 4-26



By clicking on the button on the screen, setting contents can be chosen (year/ month/ date/ hour/ second).
If the setup is completed, it has to be clicked “OK” on the screen. It can be cancelled by clicking “BACK” on the screen.

4.2.4.4 Backlight time

In System Setting Menu, “Backlight Time” has to be clicked to display the Backlight Time setup menu.
Picture 4-27

It can be chosen between 15, 30 or 45 seconds.

4.2.5 Calibration

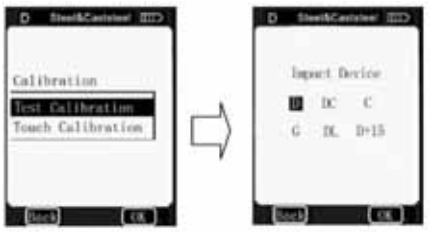
Calibration contains the **Test Calibration** and the **Touch Calibration.**
Test Calibration is used to calibrate the measured value (HL) of the hardness tester up to the farthest decrease measuring error.
Touch Calibration is used to calibrate the accuracy of the touch screen position to provide a correct and fast operation of the touch screen itself.
In System Setting menu, calibration has to be selected and clicked upon to enter the calibration screen,
see picture 4-28:

Picture 4-28

4.2.5.1 Test Calibration

There are two possibilities to get into this menu:
In Calibration menu, it has to be clicked OK on the screen to display the Test Calibration menu; or it has to be clicked directly on Test Calibration item in Calibration menu to display the Impact Device Selection menu (see picture 4-29).
In "Impact Device" selection menu, the impacrt device type has to be chosen, then "Scale" (see picture 4-30). If HL was chosen, then the calibration menu is directly shown (see picture 4-32). If another scale has been chosen, it has to be selected from "Material" menu (see picture 4-31), then the calibration menu is shown (see picture 4-32).

Picture 4-29



Calibration menu Impact Device Selection

Picture 4- 30-31-32

Fig 4.30 Fig 4.31 Fig 4.32

Five effective impact tests have to be carried out on the test block, when ALARM is set to ON, refer 4.2.4.1. If the number of impact times is less than five, OK has to be clicked and an alarm prompt will be displayed, indicating that there is an operation error. The measured values are displayed on the screen (the wrong ones can be deleted and it can be measured again) (see picture 4-33), then it has to be clicked "BACK" to get back to the Test Calibration menu.
The mean value gets automatically formed after five measurements taken.
The HLD value which is marked on the test block, has to be input by clicking on the screen keyboard. Then, by clicking OK, the Test Calibration is finished.

Picture 4-33

Note: 1. If the D Type impact unit is used to calibrate the instrument, the D Type has to be set before. The same procedure with the G Type impact unit (see items 4.1.4), or there is no one point calibration and the test value will be incorrect.
2. If the Impact Hardness Tester is used for the first time or if it hasn't been used for a longer period, it should be calibrated by using the test block.
The standard impact direction is downward (see Appendix 1 in details).
3. In Appendix 3~7 the scale and the measurement range is shown. If the set date is out of the range, the instrument will show you a failure message.

Picture 4-34

4.2.5.2 Touch Calibration

Touch Calibration is actually used to calibrate the consistency between Touch Screen sensor and LCD coordinates. If there is a deviation existing between the actual position of touch screen pressing and the actual position of the pressed figures displayed on LCD, Touch Calibration should be performed.
The coordinates of this Hardness Tester have been carefully calibrated when it was launched.
Coordinate errors may appear during the process of use due to the change of environmental conditions (especially notable changes in temperature and humidity).
Small errors can be corrected well on this function.

Picture 4-35

In Calibration menu, the Touch Calibration item has to be clicked to display the Touch Calibration menu (see picture 4-35 above).

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Picture 4-36

The cross centre can be clicked with the touch pen for Step 1 to Step 3 in picture 4-36 shown above. After completing the above three Steps, a rectangular frame will be automatically displayed in the middle of the window, see Picture 4-37:

The core of the rectangular frame has to be clicked with the touch pen and the system automatically returns to the window of calibration. Now Touch Calibration is finished.
If it isn't possible to return to the window of Calibration, the operation was inefficient. The core of rectangular frame has to be re-clicked (three times at most). If it is still inefficient after three times, it will automatically return to the window shown in picture 4-35 (step 1). All the steps of Touch Calibration should be restarted until it is performed successfully.

4.2.6 Information

Information includes developers and version information of the software and the serial number of the instrument.
Products, manufactured in different periods, may have a different software because of the version's upgrade. Therefore, we always have to be asked for advice of technical problems related to the software, we can give you further information.
In menu mode, it can be directly clicked to "Information" on the screen to open the window for information (see picture 4-38).
Note: The version number may be changing with the software upgrade, which won't be re-notified.
Picture 4-38

4.3 Charging

The batteries have to be charged before the first use and, during use, if exhaustion of electricity arises.
The capacity of battery is shown as full with three columns filled and it is shown as empty with no column is filled. The word "Power Shortage" will appear and the buzzer will beep once in two seconds to tell that it is time to charge.
First, the USB plug of the charger has to be inserted into the right USB jack of the display unit, see
Picture 4-39:

Then the charger has to be connected with the AC socket (220V/ 50Hz) to start charging (see 4-40). If the machine is at the turn-off state, charging machine will be automatically switched on and the battery symbols will be shown.
Picture 4-40

At the end of charging, "charging complete" appears on the screen. If now the ON/OFF button is pressed, the instrument won't be turned off because it is on a supervision mode.
Note: Only the exclusive charger may be used for the display unit!

4.4 Backlight

The LED backlight is used for poor light conditions. It can be automatically opened if the instrument is turned on. If there is no measurement and no touch screen operation, the backlight will be closed to save power. It will reboot as soon as a measurement is performed or any touch screen operation is done.
To set the lighting time, it has to be referred to 4.2.4.4.

5. Reset

If the display unit isn't in order or if it halts during the process of use, the Reset button can be pressed by inserting a slender rod into the ***Reset hole*** at the right side of the display unit. Then the instrument will restart.

4.6 Automatic Shutdown

The instrument will automatically shutdown in the following two cases in order to save battery power. All the parameters will be stored before turning off:
1. If there is no measurement performed and no touch operation within 3 minutes, the display unit will automatically switch off. It will beep continuously in 10 seconds before shutdown.

2. When the battery power is not sufficient, it will be displayed “power shortage”, and the buzzer will beep once a second. The display unit will automatically switch off after 10 seconds.

5. Data Printing

HMO Impact Hardness Tester can be linked with the exclusive micro printer to print out the measured values. The micro printer can be acquired as an optional device.

5.1 Printer Link

If the power of the display unit is switched off, the USB plugs of the printer cable (optional) have to be inserted into the USB jack for the printer on the right side of the display unit. The other side of the cable has to be inserted into the socket on the left side of the printer to connect both parts.
Picture 5-1

Now the printer can be booted by pressing the Power button on the printer. Then the display unit has to be turned on. Other printer operations involving printer power connecting or power recharging are attached in the printer instruction manual.

5.2 Infrared Printing

The display unit’s infrared launch window has to be put at the level of printer’s infrared receive window. In this way, infrared print can be used like serial print.

Note: When the serial cable is used to print, the infrared printing way is not possible to apply at the same time. If it is done nevertheless, the printer will print an unrecognizable code; even the paper will be non-stop output from the printer.

5.3 Test report Format

A complete test report is shown in following picture:
Picture 5-3

```
            Test Report
-----------------------------
Impact Unit Type: D
Material : Steel&Caststeel
 1   808 HLD   61.2 HRC
Date: 06/07/31  Time:18:21:27
 2   808 HLD   61.2 HRC
Date: 06/07/31  Time:18:21:27
 3   805 HLD   60.8 HRC
Date: 06/07/31  Time:18:21:27
 4   808 HLD   61.2 HRC
Date: 06/07/31  Time:18:21:27
 5   805 HLD   60.8 HRC
Date: 06/07/31  Time:18:21:27
-----------------------------
s = 3    HLD     00.4 HRC
x̄ = 806 HLD     61.0 HRC
Printed: 06/07/31     18:21:27
-----------------------------
```

5.4 Test Report Printing

HMO Impact Hardness Tester offers various typing ways. The way of typing can be flexibly chosen in the actual use.

5.4.1 Automatic Printing

If Auto Print is set to ON, the printer can automatically print during the measuring process. The data will be sent out to the printer a group of test data is completed. The title of the report will be printed before the beginning of each group of data. If Statistic Times Values is set at 1, the printer doesn’t print automatically. If this item is set at 2 to 99, the printer will automatically print the statistic group.

5.4.2 Manual Printing

If Auto Print is set to OFF, the printer can be operated manually. Manually printing can be devided in two types:
1. “Statistic Times Values” is set to 1
After every time of impact the measured values can be printed out by clicking on (in measuring mode).
The printer will automatically print the information in the title part as soon as printing starts.
2. Statistic Times Values is set at 2 to 99
If the impact times are up to user’s Statistic Times Values, has to be clicked and all the measured values and statistic results in that group will be printed out. A complete test report is formed. If is clicked before the impact times are up to the Statistic Times Values, all the finished test values will be printed. Then, if the impact times are up to user’s Statistic Times Values, has to be clicked again and the rest data and statistic results can be printed to get a complete test report.

5.4.3 Assemble Printing

Instead of printing the report during the test, it is possible to print the measured values in Printing Setup menu (see 4.2.2.2 Print Memory and 4.2.2.3 Print All).

5.4.4 Other Printing ways

It can be printed when browsing some data management pages (see 4.2.3.2 Data Browser Mode). It is also possible to print in the window of statistic list (see 4.2.4.1).
The symbol will be shown on the screen if these printing ways are available.

Note: 1. Statistic results are only shown at the ending part of the test report when automatic and manual printing ways of the Statistic Times Values are set at 2 to 99.
2. Date and time in test reports are showing the actual printing time. They don’t refer to the test dates and times.

3. Thermal printing paper should be stored in a place without high temperature and strong light. In case if storage is necessary, the copies should be stored.

6. Hardness Test

6.1 Test preparation

a) It should be reassured that the system is safe and reliable.
b) The instrument has to be switched on and it has to be checked if charging is necessary.
It has to be checked if every setting of the display unit is correct, particularly material and impact direction. A setting which doesn't conform with the actual conditions may cause a great error.

6.2 Sample preparation

Inappropriate samples will cause great measurement errors. Therefore, preparation and handling should be performed on original conditions of the sample.
Preparation of the sample and the surface to test should be coincident with the following basic requirements(just for D Type impact device, for other impact device it has to be referred to the beginning of page 4 (tables).
1) A thermal or cold processing of the impact sensors during the process of sample preparation should be avoided.
2) The surface of the sample should be plane, with a metallic sheen, and not involve oxide layer or other stains.
3) Roughness of the test surface: Ra≤ 1.6
4) The sample has to be of sufficient quality and rigidity. Otherwise displacements or shaking during the test might happen. These could also lead to measurement errors.
A sample quality of ≥ 5 kg can be directly tested. If the sample quality is 2~5 kg, it should be fixed before the test by appropriate clamps. If the sample quality is 0.05~2 kg, it should be coupled before the test; if it is < 0.05 kg, this hardness tester is inappropriate to use.
Coupling method: The testing sample's back should be plane as well as the surface of the supporting object.
A little coupling substance (i.e. Industry Vaseline) has to be filled between the two components. Then the two parts have to be pressed together. If the weight of the supporting object is more than 5 kg, it can be replaced by the test block.
5) Samples should be thick enough with sufficient layered surface. If the D-type of impact sensor is used, the thickness of the sample should be less than 5 mm and the surface absorption layer (surface- hardening layer) should not be less than 0.8 mm. To perform accurate hardness measurements, the best way is to remove this layer before testing.
6) If the testing sample surface isn't horizontal and flat, the curvature radius of the testing and nearby surface should be larger than 30 mm. An appropriate supporting ring has to be selected and installed.
7) A sample should not be magnetic. The signal of the impact sensor would be seriously affected, which might cause inaccurate test results.

7. Test Steps

How to perform the Hardness Test:
Accurate measurements are achieved by simple operating elements, even for occasional users.

1) Loading:
The loading tube has to be slided forward to load the impact device.

2) Placing:
The impact device has to be placed and held on the surface of the test piece at the desired test point.

3) Measuring:
The trigger button has to be pressed to trigger the impact device. The hardness value will be immediately displayed.

4) Reading the test result
A long operating life is provided by modern electronics with power saving features. The large LCD display always shows how HMO Impact Hardness Tester is configured to the tests. Variable function screen allows a quick change of common test parameters. On the screen hint line the other active control keys are positioned. No subjective measuring errors are possible, highly repeatable results are given to the user. Reliable test results are assured by internal self diagnostics with error messages.
Readings can be stored automatically in the internal memory or can be directly sent to a printer.
Tests in more points can be carried out by repeating the above steps 1 to 4.

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Note: Generally, each measurement location is conducted for 5 tests. The "S" value (difference of max. value and the min. value) values must be less than 12 HL. The distance between any two impact positions should be ≥ 3 mm; the distance between the impact position and the edge of the test piece should also be ≥ 3 mm.

8. Troubles and solutions

No.	Trouble	Reasons	Solutions
1	No response switched	Lack power	Recharge battery
2	Touch Screen no response	System halt	Reset
3	Touch Screen inaccurate	Parameters change	Touch Calibration (See 4.2.5.2)
4	Abnormally high results	Steel ball wearing	Replace the Steel ball
5	No test results	Sensor cables loose	Re-linking
6	Printer no response	Printer cable loose	Re-linking
* Other trouble, please contact with agencies or distributor.			

9. Maintenance and Service

9.1 Impact Device maintenance

After 1000- 2000 times use, the impact device and the impact body should be cleaned with a nylon brush. The screw of the supporting ring has to be turned off before the catheter can be cleaned. Then the impact body has to be taken out and it has to be rotated into the tube with the nylon brush in anti-clockwise direction. The brush has to be pulled out when touching the bottom.This procedure has to be repeated several times. Then the impact body has to be loaded and the supporting ring reinstalled. The impact body should be released after use. The use of any lubricant is banned.

9.2 Storage of the report

Printing paper is thermal paper and it should be preserved to avoid heat and direct light. If the print records are necessary to be kept in long-term conservation, they should be copied and preserved in time.

9.3 Normal Maintenance procedures

If the error is larger than 12HLD by calibrating the hardness tester, the steel ball or the impact body has to be renewed. Those parts may be worn out and this may lead to failure in operation.
In case if any other abnormal phenomena occur to the Hardness Tester, it should not be either demolished or any fixed assembly parts may not be adjusted. Instead, please contact us in any way and send the Hardness Tester to our Maintenance department.
We will care for a prompt checking and if necessary, repair of the device.

9.4 Service

In the following cases free maintenance is not warranted, but maintenance service is, of course, available:
1) If the device is not used in accordance to the Instruction Manual, if it has been connected or protected in the wrong way and if this leads to a damage.
2) Beyond the warranty period.
3) The Serial No. of product warranty card is not identical with the product itself.
4) Machinery parts have been disassembled or repaired by non-authorized agency or non-professional staff.
5) The parts are not in warranty (steel ball, sensor wires, frames, supporting ring components…)
6) Unexpected factors or human actions have been affecting damages, such as the use of a non-exclusive charger, high temperature, influent water, mechanical destruction and crash etc.
7) Products are damaged as a result of transportation and handling.
8) Irresistible force like earthquake and fire causing product failures.

Appendix 1 Daily Checking

The test block is mainly used to calibrate the Hardness Tester. The error and repeatability of it should be in the scope defined in following table:

Impact Device	Impact direction	Hardness of Test block (HL)	Error Allowed	Repeatability Allowed
D	↓	750～830	±12HLD	12HLD
		490～570	±12HLD	12HLD

Note:

1. Error=$\overline{HLD}$-HLD

HLD is the mean value of 5 Leeb Hardness values measured on the test block.
HLD is the value marked on the test block.

2. Repeatability= HLD_{max}-HLD_{min}

HLD_{max} is the maximum value of 5 Leeb Hardness values measured on the test block.

HLD_{min} is the minimum value of 5 Leeb Hardness values measured on the test block.

Appendix 2 Factors affecting the Accuracy

Incorrect operation or improper testing conditions can seriously affect the accuracy. The following factors are the main accounts in lack of accuracy (just for D Type impact device. For other device it has to be referred to page 4 (tables).

1) Roughness of sample surface

When the impact body impacts on the sample, a small pit will arise on the surface of it. The less roughness, the less consumption of impact energy is needed. According to this, the roughness of the surface should be Ra≤ 1.6.

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2) The shape of the sample surface

Leeb testing principle demands that the velocity of rebound and impact are on the same line, because the impact body is moving in a metal tube. Of course, hardness can also be shown if the velocity of rebound and impact are not on the same line. In this case, the impact body would collide with the tube wall when it rebounds, which will affect the velocity of rebound. This will cause an error on test accuracy. If the radius of curvature of the sample surface is smaller, a suitable variant supporting circle has to be used. We can contribute to design and release those supporting circles, if needed.

3) The weight of the sample

If the weight of the sample is more than or equal to 5 kg, testing can be directly started. If it is less than 5 kg, the sample needs a special charge. The supporting piece has to be coupled by a coupling medium and pressed onto the surface of the test piece. By doing this, better test results will be achieved.

The area of the testing points should be free of vibrations or shaking. If the weight of the sample is not enough, supporting, coupling and compressing must be increased to avoid jitter and sloshing. Shocks should be avoided.

4) The sample stability

Any effective tests need to minimize possible interference from outside. This is very important for dynamic measurements, such as Leeb Hardness testing.

Therefore, measurements are only allowed in a stable hardness testing system.

Appendix 3 Scale Range of D & DC Type

Materials	HV	HB	HRC	HRB	HSD	Tensile strength (MPa)
Steel & cast steel	81-955	81-654	20.0-68.4	38.4-99.5	26.4-99.5	375-2639
Cold work tool steel	80-898	140-651	20.4-67.1	59.6-99.6	26.4-99.5	375-2639
Stainless steel	85-802	85-655	19.6-62.4	46.5-101.7	26.4-99.5	740-1725
Grey Cast iron		93-336				
Ductile iron		140-387				
Cast aluminum alloys		19-164		23.8-84.6		
Brass		40-173		13.5-95.3		
Bronze		60-290				
Copper		45-315				
Forging steel						

Appendix 4 Scale Range of DL Type

Material	HLDL	HRC	HRB	HB	HV	HSD
Steel	560-950	20.6-68.2	37.0-99.9	81-646	80-950	30.6-96.8

Appendix 5 Scale Range of C Type

Material	HLC	HRC	HRB	HB	HV	HSD
Steel	350~960	20.0~69.5	38.4~99.5	80~683	80~996	31.9~102

Appendix 6 Scale Range of D+15 Type

Material	HLD+15	HRC	HB	HV	HSD
Steel	481~850	19.3~67.9	80~638	180~818	33.3~99.3

Appendix 7 Scale Range of G Type

Materials	HLG	HRB	HB
Steel	300~750	47.7~99.9	90~646
GC.IRON	340~600		92~326
NC.IRON	340~600		127~364

DESIGNED IN REGARD TO THESE STANDARDS:

- **ASTM A-956-02**
- **DIN 50156**

10. Declaration of conformity

SAUTER

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Konformitätserklärung

Declaration of conformity for apparatus with CE mark
Konformitätserklärung für Geräte mit CE-Zeichen
Déclaration de conformité pour appareils portant la marque CE
Declaración de conformidad para aparatos con marca CE
Dichiarazione di conformità per appare-chi contrassegnati con la marcatura CE

English We hereby declare that the product to which this declaration refers conforms with the following standards.

Deutsch Wir erklären hiermit, dass das Produkt, auf das sich diese Erklärung bezieht, mit den nachstehenden Normen übereinstimmt.

Français Nous déclarons avec cela responsabilité que le produit, auquel se rapporte la présente déclaration, est conforme aux normes citées ci après.

Español Manifestamos en la presente que el producto al que se refiere esta declaracion est a de acuerdo con las normas siguientes

Italiano Dichiariamo con ciò che il prodotto al quale la presente dichiarazione si riferisce è conforme alle norme di seguito citate.

LEEB Hardness Tester: SAUTER HMO

Mark applied	EU Directives	Standards
CE	2004/108/EC	EN61000-6-2: 2005 EN61000-6-4: 2007

Date: 07.01.2009

Signature:

SAUTER GMBH
Management