

Digital Hardness Tester

EMHT- 40

Instruction Manual

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1. Introduction

EMHT-40 is an advanced mini hardness tester, characterized by its high accuracy, wide measuring range and simplicity for operation. It is suitable for testing hardness of the ordinary metal and widely applied in many industrial fields, such as petroleum, chemistry machinery and electric power industries etc.

2. Principle of Leeb hardness testing method

2.1 History of Leeb hardness testing method

The Leeb hardness testing method was firstly used in 1978. It is defined as: the rebound velocity of impact body divided by the impact velocity and then multiplied by 1000. For specified metals, Leeb hardness values indicate the hardness relations, and it can also be converted to other hardness scales (eg. HB, HV, HRC).

2.2 Definition of Leeb hardness

The impact body, which is equipped with tungsten carbide, impacts into the work piece and rebounds back. The rebound and impact velocities are measured at the 1mm point from the work piece in the following way: the integrated permanent magnet will produce directly proportional voltage with the impact velocity. The Leeb hardness values are calculated by the following formula:

$$HL=1000\times (V_b / V_a)$$

In Which: HL: Leeb hardness values

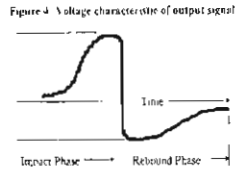
V_b : the voltage produced during the rebound of impact body

V_a : the voltage produced during the impact of impact body

Figure 1 shows the voltage produced during the impact and rebound of impact body:

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Figure 1.voltage features of output signal



The Leeb hardness values can be converted to other hardness scales directly, such as HV, HRC, HRB, HB and HS.

2.3 Symbol of Leeb hardness values

Just like the other hardness scales, users will get different hardness values with different impact devices, for example: 720HLD \neq 720HLC.

Because Leeb hardness values are produced by the responding impact devices, it should be expressed with its impact device when it is converted to other hardness scales. For example: the Leeb hardness value 510HLD should be expressed as below when it is converted to Rockwell hardness scales HRC:

510, 20 HRCLD

In which:

- 510** Leeb hardness values
- 20** converted hardness values
- HRC** means the converted object
- L** means the measuring method
- D** means D impact device

3. Pre-treatment of work piece

To get the accurate measuring results, pre-treatment of work piece is required.

3.1 work piece surface

- Temperature of work piece should be less than 80°C ;
- The surface roughness requirements are listed in table 3.1.1

Table: 3.1.1

| Impact device | Work piece surface roughness |
|---------------|------------------------------|
| D, DC, D + 15 | 2 μ m |
| G | 7 μ m |
| C | 0.4 μ m |

- The small support ring or non-conventional support rings are required for work piece with curved surface radius less than 30mm, for details please refer to appendix 2.

3.2 weight of work piece

- No support is required for work piece weight more than 5kg.
- Work piece with medium-weight of 2-5kg and also heavier work piece 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.
- Light- weight work piece should be rigidly coupled with a non-yielding support such as a heavy base plate.

Work piece weight and height 3.2.1

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Table 3.2.1

| Impact device type | weight (kg) | | | Minimum thickness of work piece (mm) |
|--------------------|-----------------|-----------------|---------|--------------------------------------|
| | Needing coupled | Needing support | No need | |
| D、DC、D + 15 | 0.05-2 | 2-5 | >5 | 3 |
| G | 0.5-5 | 5-15 | >15 | 10 |
| C | 0.02-0. 5 | 0.5-1.5 | >1.5 | 1 |

3.3 work piece surface hardened layer

If the work piece surface hardened layer is too thin, the impact force of short duration will go through the layer and make the L-value incorrect. The proper depth surface hardened layer are listed below:

Tale: 3.3.1

| Impact device | Minimum depth of surface hardened layer (mm) |
|---------------|--|
| D, DC, D + 15 | 0.8 |
| C | 0.2 |

3.4 No strong magnetism on the work piece surface

Strong magnetism will affect the circuit winding greatly, and affect the accuracy of testing results, so it is required to avoid strong magnetism during the testing.

4. Typical Applications

- Installed machines and permanent parts of assembled system

- Molding surface of die
- Heavy work-pieces
- Ineffectiveness analysis of pressure-vessel, turbo-generator set etc.
- Bearing and other messy produced parts at production line
- Obtaining test data requested as original formal records
- Identifying metallic material stored in a warehouse

5. Functions of EMHT- 40 hardness tester

5.1 Technical specifications

Display: 112×64 LCD

Display error: $\pm 0.5\%$

Relative repetitive display error: $\pm 0.8\%$

Memory: 1250

Battery: 3.7V rechargeable lithium-battery with working more than 16 hours continuously

Auto-off: 2 minutes without working

Size: 158×41×26 mm

Weight: 120g

5.2 EMHT- 40 Hardness Tester

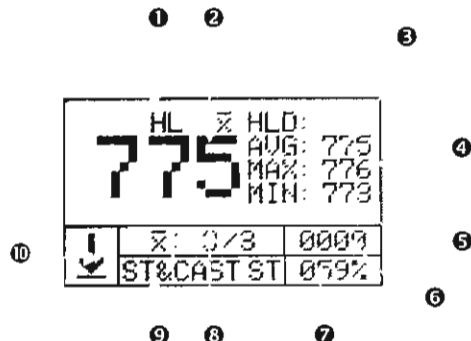
5.2.1 Main Body

- ① LCD display
- ② USB port/charging port
- ③ Impact device
- ④ Name plate (back)




⑤ Keypad

5.2.2 Function of Display

- ① Hardness scale
- ② Measuring value
- ③ Average value
- ④ Maximum value
- ⑤ Minimum value
- ⑥ Memory location
- ⑦ Battery power
- ⑧ Times of measurement/average
- ⑨ Material
- ⑩ Direction




5.2.3 Keypad

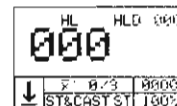
- ①  ON/OFF/Menu /Esc
- ②  Select/Move/Delete
- ③  Select/Set/Change the Display




6. Operation of the Instrument

6.1 starting and turning off

Press  key turning on the power, then detailed items of available function last-use will display on the LCD.






Hold  key for more than 3 seconds, turn the instrument off.

Prompt: You can press  **key to change the display style.**


6.2 Function of Menu

Users can change or modify the function of gauge by selecting different items of menu.

Press  key into menu state, then press  key or  key to select item you want to change or modify.

| | | |
|-----------------------|--------------------|-----------------------|
| 1 MEASUREMENT | 5 SCALE | 9 OUTPUT |
| 2 DIRECTION | 6 TOLERANCE | 10 CALIBRATION |
| 3 AVERAGE TIME | 7 LOCATION | 11 CONTRAST |
| 4 MATERIAL | 8 MEMORY | 12 DEFAULT |





6.2.1 Measurement

- Press  key, the gauge will go back measurement state.

6.2.2 Direction

You can select 5 directions.

| | |
|-----------------------|----------------------------------|
| 1 MEASUREMENT | DIRECTION |
| 2 DIRECTION | 1 ↓ 2 ↘ 3 → |
| 3 AVERAGE TIME | 4 ↗ 5 ↑ |
| 4 MATERIAL | |





- Press  key to into the item
- Press  key or  key to select the direction
- Press  key to confirm

Prompt: The direction you selected must be the same as you use.

6.2.3 Average Times

The average times can be selected from 2 to 8.

| | |
|------------------------|---------------|
| 1. MEASUREMENT | AVERAGE TIMES |
| 2. DIRECTION | 3. |
| 3. AVERAGE TIME | |
| 4. MATERIAL | |

- Press  key to into the item
- Press  key or  key to increase or to decrease the average times
- Press  key to confirm

Prompt: 3 or 5 average times are to be recommended

6.2.4 Material

The gauge provides 9 types of material,





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1. MEASUREMENT
2. DIRECTION
3. AVERAGE TIME
4. MATERIAL

1. ST CAST ST
2. CWT STEEL
3. STAINLESS
4. GC IRON

5. NC IRON
6. CAST ALUM
7. BRASS
8. BRONZES

9. COPPER





- Press  key to into the item
- Press  key or  key to select the required material
- Press  key to confirm

6.2.5 Scale

6 types of scale can be selected according to measurement.

5. SCALE
6. TOLERANCE
7. LOCATION
8. MEMORY

SCALE
1. HL 2. HRC
3. HRB 4. HB
5. HS 6. HV

- Press  key to into the item
- Press  key or  key to select the required scale
- Press  key to confirm





6.2.6 Tolerance

If the measurement value is lower than the lower limit value or upper than the upper limit value, the sign

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“L” or “H” will appear on the LCD.





| | |
|---------------------|---------------|
| 5. SCALE | TOLERANCE |
| 6. TOLERANCE | LOWER. 100 HL |
| 7. LOCATION | UPPER. 500 HL |
| 8. MEMORY | |

- Press  key to into the item
- Press  key to increase limit value
- Press  key to change setting value
- Press  key to confirm

6.2.7 Location

The gauge provides 1250 memory locations, from 0000 to 1249.

| | |
|--------------------|---------------|
| 5. SCALE | SET LOCATION |
| 6. TOLERANCE | LOCATION 0000 |
| 7. LOCATION | |
| 8. MEMORY | |





- Press  key to into the item
- Press  key to increase location value
- Press  key to change setting value
- Press  key to confirm

6.2.8 Memory

You can select "AUTO STORE" or "CLOSE STORE" states to determining store or not store measuring value.




5. SCALE
6. TOLERANCE
7. LOCATION
8. MEMORY

1. AUTO STORE
2. CLOSE STORE
3. CLEAR MEMORY

- Press  key to into the item
- Press  key or  key to select the required item
- Press  key to confirm

If you want to clear the memory built-in EMHT-40, you can go to the item "CLEAR MEMORY" and setup the locations you want to clear.

INPUT LOC
0000 0000
^





- Press  key or  key to select the required item
- Press  key to confirm

6.2.9 Output

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Through determining the desired initial and end location number, you can output the value stored in the gauge to PC.




| | |
|-----------------|-----------------|
| 9. OUTPUT | OUTPUT |
| 10. CALIBRATION | START LOC. 0001 |
| 11. CONTRAST | END LOC. 0300 |
| 12. DEFAULT | |

- Press  key to into the item
- Press  key to increase location value
- Press  key to change setting value
- Press  key to confirm

6.2.10 Calibration

You can modify measurement value when an error happening by changing desired value.

| | |
|-----------------|-----------------|
| 9. OUTPUT | CALIBRATION |
| 10. CALIBRATION | CAL. RANGE 2.09 |
| 11. CONTRAST | AUG. DATA 000 |
| 12. DEFAULT | CAL. DATA 1.27 |





- Press  key to into the item
- Press  key to increase calibration value
- Press  key to change setting value

- Press  key to confirm

6.2.11 Contrast

If you want to change the LCD contrast, you can go to the item and adjust the LCD contrast.

| | |
|---------------------|-----------|
| 9. OUTPUT | CONTRAST |
| 10. CALIBRATION | |
| 11. CONTRAST | ┌───┐ |
| 12. DEFAULT | 1 2 3 4 5 |

- Press  key to into the item
- Press  key to increase contrast value
- Press  key to decrease contrast value
- Press  key to confirm

6.2.12 Default

The gauge will recover the default parameters when confirm "DEFAULT" state.

| |
|--------------------|
| 9. OUTPUT |
| 12. CALIBRATION |
| 11. CONTRAST |
| 12. DEFAULT |

- Press  key to confirm

6.3 Data output via USB

EMHT-40 hardness tester supplies user very powerful USB data port for transferring saved data to computer.

6.3.1 Installation of USB driver program

When the instrument is connected to computer, it will be recognized immediately and installation of USB driver program is required. Install the program from CD supplied by us as the instruction files in the CD (EMHT-40 SetupFiles).

6.3.2 Installation of DataReceiver software

After the installation of USB driver, it is required to set up the DtaReceiver software which is also in the CD (EMHT-40 USB-DataReceiver-Setup) to C: Program Files/USB-DataReciever.

6.3.3 Transferring of data

For the transferring of data, please refer to chapter **6.2.9. OUTPUT**.

Prompts : *It is necessary to preset the proper communication port number of the computer before transferring of data.*

7. Repairing and Maintenance

In order to keep the accuracy and reliability of the instrument, it is necessary of timely evaluation and maintenance.

7.1 Maintenance of battery

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The battery of EMHT-40 should be charged timely to avoid damaging the battery. The proper charging time is about 4 hours.

7.2 Maintenance of impact body tip

Because of the abrasion of impact body tip, the measured values may get larger than the standard value or get bad repeatedly. When it gets a larger measured value but not a bad repeatedly, it can be corrected by error correction function, for details please refer to **“6.2.10 Calibration”**. If it gets a larger measured value and also a bad repeatedly, just change the impact body tip.

7.3 Maintenance of instrument


EMHT-40 is supplied with two year's certification of maintenance. Users should read the maintenance items below.

8. Appendix







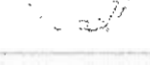


Appendix 1: Measuring/ converted range of impact device D:

| Materials | HL | HRC | HRB | HB | | HS | HV |
|--------------|---------|-----------|------------|------------------|------------------|-----------|--------|
| | | | | 30D ² | 10D ² | | |
| ST & CAST ST | 300~900 | 20.0~68.0 | 38.4~99.5 | 80~647 | | 32.5~99.5 | 80~940 |
| CWT STEEL | 300~640 | 20.4~67.1 | 46.5~100.7 | | | | 80~898 |
| STAINLESS | 300~800 | 19.6~62.4 | | 85~656 | | | 85~802 |
| GC IRON | 360~650 | | | 90~334 | | | |
| NC IRON | 400~660 | | | 131~367 | | | |
| CAST ALUM | 174~560 | | | | 20~190 | | |
| BRASS | 200~550 | | 13.5~95.3 | | 40~173 | | |
| BRONZES | 300~700 | | | | 60~290 | | |
| COPPER | 200~690 | | | | 45~315 | | |

Appendix 2: Non-conventional support rings

| No | Code | Type | Sketch | Remarks |
|----|---------|----------|---|---|
| 1 | 03-03.7 | Z10-15 |  | For cylindrical outside surface R10-R15 |
| 2 | 03-03.8 | Z14.5-30 | | For cylindrical outside surface R14.5 ~ R30 |
| 3 | 03-03.9 | Z25-50 | | For cylindrical outside surface R25 ~ R50 |

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| | | | | | |
|----|----------|-----------|---|--|---------------|
| 4 | 03-03.10 | HZ11-13 |  | For cylindrical inside surface | R11 ~ R13 |
| 5 | 03-03.11 | HZ12.5-17 |  | For cylindrical inside surface | R12.5 ~ R17 |
| 6 | 03-03.12 | HZ16.5-30 |  | For cylindrical inside surface | R16.5 ~ R30 |
| 7 | 03-03.13 | K10-15 |  | For spherical outside surface | SR10 ~ SR15 |
| 8 | 03-03.14 | K14.5-30 |  | For spherical outside surface | SR14.5 ~ SR30 |
| 9 | 03-03.15 | HK11-13 |  | For spherical inside surface | SR11~SR13 |
| 10 | 03-03.16 | HK12.5-17 |  | For spherical inside surface | SR12.5 ~ SR17 |
| 11 | 03-03.17 | HK16.5-30 |  | For spherical inside surface | SR16.5 ~ SR30 |
| 12 | 03-03.18 | UN |  | For cylindrical outside surface, radius adjustable | R10 ~ ∞ |

Note: We will not play any notification on modification of this manual.

PACKING CARD

| Code | Content | Quantity | Remarks |
|------|--------------------------------|----------|---------|
| 1 | Main unit with impact device D | 1 | |
| 2 | small support ring and brush | 1 | |
| 3 | Standard hardness test block | 1 | |
| 4 | AC Adapter/Charger | 1 | |
| 5 | Instruction files | 1 | |
| 6 | Software (CD) | 1 | |
| 7 | USB connecting cable | 1 | |
| 8 | Carrying case | 1 | |
| | | | |
| | | | |