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HDT-DM Series
Motorized Digital Rockwell / Superficial Rockwell
Hardness Tester Operation Manual



1. INTRODUCTION

1.1 Outline

The Rockwell hardness tester is special equipment for determining material hardness. In the testing of material mechanical properties, hardness measurement is one of the simplest, most economical and most convenient methods. It can not only quickly obtain the hardness index, but also use the correlation between hardness and other mechanical properties to deduce other mechanical properties such as strength, fatigue, creep, wear and internal damage. Therefore, hardness testing is widely applied.

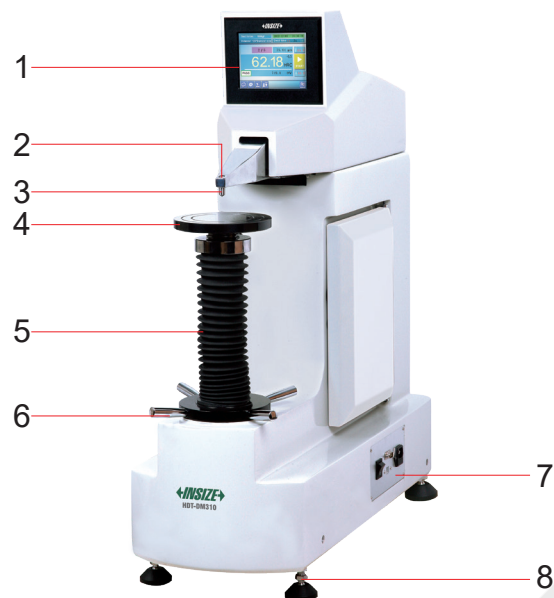
1.2 Measuring principle

At the start of the test, the specimen is raised so that the tester's indenter is pressed against the specimen, an initial test force is applied, and a reference point is established by the position sensor. The primary test force is then applied by the tester to press the indenter deeper into the surface of the specimen. Finally, the main test force is removed and the position of the indenter at this point is measured while the initial test force is maintained. This position is compared with the reference point and the resulting displacement difference is substituted into the Rockwell hardness formula to calculate the material hardness.

1.3 Implementation standards

- ISO 6508-2: Metallic materials-Rockwell hardness test-Part 2: Verification and calibration of testing machines and indenters.
- BS EN ISO 6508-2: Metallic materials-Rockwell hardness test-Part 2: Verification and calibration of testing machines (scales A, B, C, D, E, F, G, H, K, N, T).
- GB/T 230.2: Metallic materials—Rockwell hardness test—Part 2: Verification and calibration of hardness testers and indenters.

2. PRODUCT ILLUSTRATION



1-Front panel and keypad
2-Indenter mounting seat
3-Indenter
4-Specimen stage

5-Lifting screw and protective sleeve
6-Lifting handwheel
7-Switch and power cord connection board
8-Leveling screw

3. SPECIFICATIONS

3.1 Test Types:

- 1) HDT-DM290 supports Rockwell scales only;
- 2) HDT-DM300 supports superficial Rockwell scales only;
- 3) HDT-DM310 supports all Rockwell and superficial Rockwell scales.

3.2 Test Scales:

Rockwell scales (with standard indenter): HRA, HRB, HRC, HRD, HRF, HRG;
Superficial Rockwell scales (with standard indenter): HR15N, HR30N, HR45N, HR15T, HR30T, HR45T;
Rockwell scales (with optional indenter): HRE, HRH, HRK, HRL, HRM, HRP, HRR, HRS, HRV;
Superficial Rockwell scales (with standard indenter): HR15W, HR30W, HR45W, HR15X, HR30X, HR45X, HR15Y, HR30Y, HR45Y.

3.3 Hardness Conversion: Vickers, Brinell, Knoop, Leeb, Tensile Strength

3.4 Preliminary Test Force: Rockwell 98.07N (10kgf);
Superficial Rockwell 29.42N (3kgf).

3.5 Total Test Force:

Rockwell: 588.4N (60kgf), 980.7N (100kgf), 1471N (150kgf);
Superficial Rockwell: 147.1N (15kgf), 294.2N (30kgf), 441.3N (45kgf).

3.6 Worktable Lifting: Manual.

3.7 Load Control: Automatic (Load/Hold/Unload).

3.8 Display Resolution: 0.01HR.

3.9 Dwell Time: 2~250s.

3.10 Max. Specimen Height: 290mm.

3.11 Distance from Indenter Center to Machine Body: 220mm.

3.12 Internal Probing Depth: 130mm.

3.13 Minimum Measurable Inner Diameter: 35mm.

3.14 Power Supply: 220V, 50/60Hz.

3.15 Machine Dimension (L×W×H): 700*290*880mm.

3.16 Net Weight: 85kg.

4. SETTING

4.1 Preparation before installation

- 1) Check all items against the packing list in the manual appendix.
- 2) The mounting platform shall support at least 3 times the total weight of the hardness tester, accessories and specimens, and be substantially level.
- 3) The mounting platform shall be free from mechanical vibration.
- 4) A $\Phi 70$ mm round hole is recommended on the platform for unobstructed screw travel; maximum downward stroke of the screw is 300mm.
- 5) Ambient conditions: dry, clean, no corrosive media or strong magnetic fields, temperature (10~35)°C.
- 6) Keep sufficient clearance between the hardness tester and walls for routine maintenance.
- 7) Power supply within 1m of the tester, with stable voltage, reliable grounding and no interference.
- 8) Prepare required tools: screwdrivers, wrenches, lifting gear, level gauge, scissors and flexible protective materials.

WARNING: The power supply must be reliably grounded. Poor grounding may cause machine malfunction, personal injury or property damage!

4.2 Installation

- 1) Unpack, remove fixing screws on the bottom pallet, then move the hardness tester to the prepared workbench. Use the 4 supplied special handles, screwed into threaded holes on both sides for handling. Never lift the machine by the top, upper cover, lever, side door or other non-load-bearing parts.
- 2) Install the 4 adjustable feet (supplied) on the machine base.
- 3) Remove all packaging and foam cushions.

4) Connect the power cord. Turn the handwheel to lower the sample stage slowly. Place the level gauge on the sample stage to check levelness. Adjust using the leveling screws at the base and tighten lock nuts after adjustment.

(Note: Level adjustment is critical. An unlevel machine may reduce test accuracy.)

5) Dispose of packaging waste properly to prevent environmental pollution.

5. HARDNESS TEST

5.1 Preparation for hardness testing

- 1) Connect the power cord and turn on the machine switch. The tester will perform self-test, displaying machine name, model, serial number, manufacturer and other relevant information. After self-test, it enters the main menu, and the screen shows current test parameters automatically saved from the last shutdown.
- 2) Select the appropriate sample table according to the specimen size and shape, mount it on the top of the lifting screw, and ensure the contact surface is clean during installation.
- 3) Predict the hardness range based on the specimen material and manufacturing process, then select the proper hardness scale and test parameters. Table 1 lists the scale parameters and applicable materials measurable by this machine.
- 4) Refer to Table 1 for the indenter matching the selected hardness scale, then install it into the indenter holder. The mounting holes, end faces and shank of the indenter must be kept clean during installation.
- 5) After selecting the scale via on-screen buttons, the machine automatically switches to the correct test force with no extra manual operation.

Table1

Scale	Indenter	Test force	Applicable Materials
HRA	Diamond indenter	588.4N	Carbide, surface hardened materials
HRD	Diamond indenter	980.7N	Medium hardened steel, malleable iron
HRC	Diamond indenter	1471N	Quenched parts, QT steel, hard cast steel, etc.
HRF	Ø1.5875mm ball indenter	588.4N	Cu alloys, soft sheet alloys
HRB	Ø1.5875mm ball indenter	980.7N	Annealed steel, Cu, Al&alloys
HRG	Ø1.5875mm ball indenter	1471N	Malleable iron, Cu-Ni-Zn alloy
HRH	Ø3.175mm ball indenter	588.4N	Al, Zn, Pb, etc.
HRE	Ø3.175mm ball indenter	980.7N	Cast iron, Al-Mg alloys, bearing alloys
HRK	Ø3.175mm ball indenter	1471N	Bronze, Be bronze
HRL	Ø6.35mm ball indenter	588.4N	Bearing alloys, ultra-soft metals (Al,Zn,Pb,Sn), engineering plastics
HRM	Ø6.35mm ball indenter	980.7N	
HRP	Ø6.35mm ball indenter	1471N	
HRR	Ø12.7mm ball indenter	588.4N	
HRS	Ø12.7mm ball indenter	980.7N	
HRV	Ø12.7mm ball indenter	1471N	

Tip: The indenter shown on screen must be physically installed on the hardness tester. If using the machine for the first time without an indenter, install the correct indenter as prompted. If an indenter is already fitted, verify that the installed indenter matches the indication on the display.

5.2 System settings

Press the “” button in Fig.2, the menu shown in Fig.3 appears. All parameter settings are completed in this menu. The functions of each button are as follows:

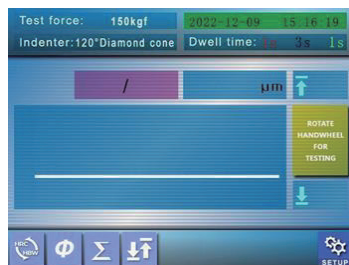


Fig.2



Fig.3

1) Scale selection

Press the “” key, Fig.4 appears. Select the test scale such as HRC, then press OK to return. Taking HRC as an example, the machine automatically sets the corresponding test force of 150kgf, and prompts on the main screen that the indenter for this scale is a 120° diamond indenter. Please verify whether the installed indenter is correct, or reinstall the indenter.



Fig.4

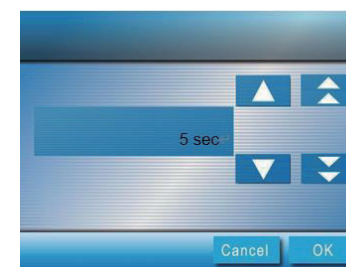


Fig.5

2) Setting of test time

Test time parameters can be set separately: preliminary test force F0 holding time, load dwell time and recovery time.

Preliminary test force F0 holding time: Press the “” key, Fig.5 appears. The operator can set the F0 holding time. For metallic materials, this time is generally 1~4 seconds. For higher efficiency, it is normally set to 1 second.

Load dwell setting: This refers to the combined holding time of preliminary test force F0 and main test force F1 (F0+F1). For metallic materials, it is generally set to 2~6 seconds. For setup, press the “” key, then input parameters in the same way.

Recovery: Recovery time is the interval from removal of main test force to reading of final indentation depth. For metallic materials, it is generally set to 1 second; for plastic materials, 15 seconds. For materials with elastic recovery, indentation recovery time can be set from 1 to 50 seconds according to elastic deformation magnitude to meet requirements of different materials. For setup, press the “” key, input method is the same as above.

After setup, values are displayed in red, black and green respectively as shown in Fig.2: preliminary test force 2 s, dwell time 3 s, recovery time 1 s.

3) Calibration

Press the “” key, Fig.5 appears. Select the scale to be calibrated and press OK to enter Fig.6, where calibration values can be entered. Minor errors occurring during daily use can be corrected with this function. Each scale can be calibrated independently without mutual interference. To ensure measurement accuracy and objectivity, calibration shall be managed by assigned personnel.



Fig.5

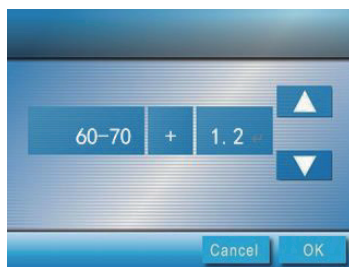


Fig.6

4) Data management

Press the “” key to view measurement data. The hardness tester automatically records every measurement.

5) Depth

Press the “” key, the hardness tester enters the direct calibration program for depth measuring mechanism. This machine supports direct calibration complying with ASTM E18. This calibration must be performed by professional metrology departments with dedicated equipment. (Tip: Ordinary users do not need to access this program. If necessary, contact our technical service department for professional operation guidance.)

6) Administrator

Press the “” key to enter administrator program for hardness tester maintenance. This program is generally used by the manufacturer for equipment maintenance (password required). Users shall not enter this program or modify parameters arbitrarily.

7) Printing and data transfer

Press the “” or “” key. Each press toggles the icon solid (setting enabled) or hollow (setting disabled). When enabled, measurement results will be printed synchronously or transmitted to a computer after each test.

8) Time

Press the “” key. The operator can set current time including year, month, day, hour, minute and second.

5.3 Auxiliary functions

The hardness tester main interface has four auxiliary function options: “” Scale conversion, “” Surface correction, “” Data statistics and “” Upper and lower limit settings. These functions can be selected individually, multi-selected or fully enabled. The corresponding icon changes from hollow to solid upon selection. Press each function key once to enable the setting (icon solid); press again to disable it (icon hollow). The detailed functions and setup procedures are described below.

1) Scale conversion: Press the “” key, Fig.7 appears. Select the target hardness scale for conversion (e.g. HV), then press the Enter key to confirm. After enabling this function, converted values will be displayed together with test results. For example, a measured value of 62.18 HRC converts to 749.8 HV.

Available scale conversions for this instrument:



Fig.7

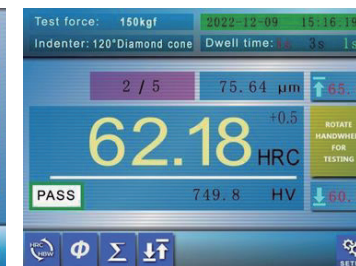


Fig.8

HRA to HBS, HBW, HV, HK, HR15N, HR30N, HR45N, HB(Cu), HV(Cu);
HRC to HBS, HBW, HV, HLD, σb, HK, HR15N, HR30N, HR45N, HB(Cu), HV(Cu);
HRB to HB10, HB30, HV, HLD, σb, HK, HR15T, HR30T, HR45T, HB(Cu), HV(Cu),
HB(Al), HV(Al), σb(Al), HB(d-Al), σb(d-Al);
HRD to HV, HK, HB;
HRE to HV, HK, HB, HV(Al), σb(Al), HB(d-Al), σb(d-Al);
HRF to HV, HB, HB(Cu), HV(Cu), HB(Al), HV(Al), σb(Al), HB(d-Al), σb(d-Al).

Each conversion is valid only within specified hardness ranges defined by national standards. The instrument prompts "E" when out of range. Conversions without material labels apply to common ferrous metals; Cu-labeled items apply to copper and copper alloys; Al-labeled items apply to aluminum and aluminum alloys. d-Al denotes aluminum alloys with cladding.

2) Surface correction: Press the " Φ " key. If the test workpiece has a cylindrical surface, input the cylinder radius (valid range: 3~19 mm). For spherical surfaces, input the sphere diameter (valid range: 4~25 mm). Press Enter to confirm. Once enabled, the surface correction value displays alongside each test result.

Note: The original uncorrected reading and correction value are shown separately.

3) Data statistics: Press the " Σ " key, enter the sample count N, then press Enter to confirm. When enabled, each test shows the current sequence number and total sample count N. After the final measurement, the tester automatically calculates the mean value, standard deviation S, maximum Max, minimum Min and range R. Mean, standard deviation and range are calculated using the formulas below.

$$\bar{X} = \frac{1}{N} \sum X_i,$$

$$S = \sqrt{\frac{1}{N-1} \sum (\bar{X} - X_i)^2}$$

$$R = \text{Max} - \text{Min}$$

These results can be directly used for uncertainty evaluation. Press Return to go back to the main menu.

By convention, the first measurement is a seating point and excluded from statistics, labeled as the 0th measurement. Starting from the second measurement, counting begins at 1. The sequence number increments automatically after each test until N measurements are completed, then the statistical results are displayed.

4) Upper and lower limit settings: Press the " $\updownarrow$ " key and input upper and lower limit values. After activation, limits are shown with every test result. If the measured value falls within the set range, the screen displays "qualified"; if out of range, it shows "out of tolerance".

5.4 Start testing

Place the test specimen at the center of the test bench. Rotate the lifting handwheel clockwise to raise the test bench until the specimen lightly touches the indenter. Continue raising the test bench; the screen displays an animation simulating the test process. When the simulation animation shows contact with the indenter tip, the preload is applied, accompanied by a beep. Immediately stop turning the handwheel. The hardness tester then automatically completes loading, holding and unloading the test force until measurement finishes.

Tip: Minor overshoot of the test bench during rising does not affect measurement; the test continues automatically. Excessive rising will trigger an automatic alarm, prompting to change the test point and restart.

5.5 End of test

Remove all test force and switch off the power. For long-term disuse, cut off the power supply and remove the indenter for proper storage.

6. TROUBLESHOOTING

WARNING:

Disconnect the power supply before handling any of the faults described below. Failure to do so may impair normal machine operation and cause personal injury or property damage!

- 1) During parameter setting, some setup procedures must be completed to the final step and do not support mid-exit. If the process stops or misoperation occurs, resulting in a "crash"-like phenomenon, shut down and restart directly.
- 2) No display upon power-on. Verify normal power supply, correct wiring, intact and properly installed fuses inside the power filter, and integrity of the three fuses on the power board.
- 3) Garbled LCD display or no backlight. Check for strong electromagnetic interference in the surrounding environment; or remove the top cover to verify secure connection of the LCD cable connector.
- 4) The screen fails to return to the main menu within 10 seconds after power-on, or abnormal motor noise is heard. Power off the machine immediately, open the rear cover and check if the position switches are in their correct positions.
- 5) Large error in measured values. First verify correct and secure installation of the indenter, check for damage to the anvil table, and confirm stable and firm placement of the hardness specimen.
- 6) Contact our company for other malfunctions.

7. ROUTINE MAINTENANCE

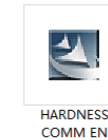
- 1) To ensure accurate test results, the indenter must be kept clean and free of wear or damage. Carefully load and unload the indenter to protect the tip from damage and contamination. Non-operational mechanical impact on the indenter is prohibited. Remove and properly store the indenter for long-term disuse, and take anti-rust precautions.
- 2) Use the dedicated carrying handle when moving the hardness tester. Do not move the indenter base. Restore the original packaging and add necessary protective measures for long-distance transportation.
- 3) Fit the dust cover when stopping daily use. Maintain the working environment to prevent rust, dust and corrosive media.
- 4) The protective sleeve on the lead screw serves for daily dust prevention. Keep it fitted for small workpiece measurement (factory default state). Remove the sleeve when testing large workpieces that require substantial lowering of the anvil table.
- 5) Keep the specimen table and standard hardness block surfaces clean and free of contamination. Avoid mechanical damage such as scraping and impact. Apply anti-rust oil during storage.
- 6) Disconnect the power supply in all cases of internal commissioning and inspection, such as removing the top and rear covers.
- 7) Never disassemble or adjust fixed assembled parts on your own; otherwise, the machine accuracy may be affected.
- 8) Inspect the hardness tester periodically according to usage frequency. Inspect indenter wear, machine accuracy and repeatability. This is generally done by comparing measured values against a standard hardness block.
- 9) Periodic verification of the machine is required. Comply with local regulations and code requirements of the user.

8. NOTES

- 1) Four handles are supplied in the accessory case. Screw them into both sides of the machine body for machine transportation only.
- 2) DO NOT lift or move the machine by applying force on the indenter holder (long nose).
- 3) The material testing system is a potential hazard. High test load, mechanical movement and stored energy within the system create inherent risks. All moving and working components, especially the indenter, carry potential dangers.
- 4) Read this manual carefully and follow all WARNING, CAUTION and TIP statements. "WARNING" indicates hazards that may cause personal injury or death; "CAUTION" indicates hazards that may result in equipment damage or data loss; "TIP" provides information to maintain normal machine operation, improve test accuracy or present basic knowledge.
- 5) Wear safety goggles and use protective plates or screens when specimens pose potential hazards. A wide range of specimens may be tested. It is the responsibility of the equipment owner and operator to fit adequate protection for the specimen under test. Hazards arising from the specimen itself shall be borne by the equipment owner and operator.
- 6) Protect all cables from damage and reverse connection. Unprotected cables shall not be laid on the ground, and overhead cables shall not be tensioned excessively. Where cables pass through wall holes or corners, use standard filler material for cable protection against abrasion.
- 7) Use caution when placing or removing specimens. Specimens must pass through the gap between the indenter and the sample stage during handling. Keep clear of this hazardous zone while machine components are moving.

9. SOFTWARE INSTALLATION

- 1) Locate the USB flash drive supplied with the hardness tester, click the software installation icon and follow the on-screen prompts.

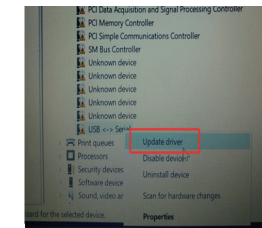
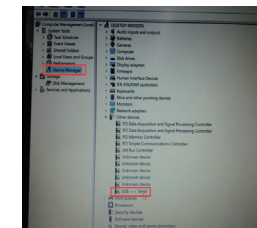


Click to start installation

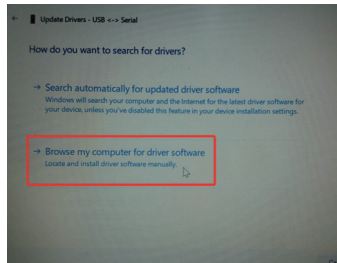
- 2) The icon shown below will appear after successful software installation.



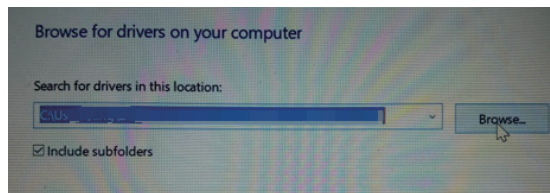
- 3) Driver installation: Connect the hardness tester main unit to the computer via the USB data cable, then launch the data transfer software icon on the interface.
- 4) Open Windows Device Manager, locate the unrecognized port, right-click and select Update driver.



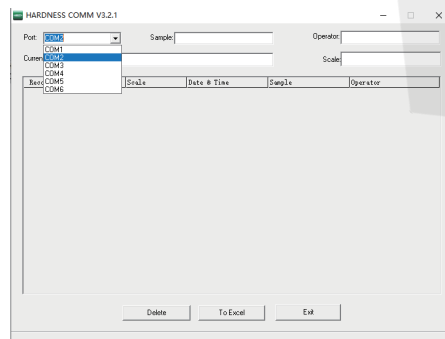
5) Select Browse my computer for driver software to manually locate and install the driver.



6) Navigate to the driver folder and select it to install the driver.



7) After successful driver installation, select the proper port for connection to start testing. Data will be transmitted automatically after each test.
(Sample name, operator, hardness unit and other information must be filled manually; the hardness unit will not change with switching on the main unit.)



Note:

Data transfer via the software is unavailable when the data statistics function is enabled.
Data transfer only works for single-point tests.