

MODEL HVS-1000TA-XY AUTOMATIC VICKERS HARDNESS MEASURING SYSTEM

Overview

HVS-1000TA-XY automatic micro Vickers hardness measuring system integrates many current professional technologies, such as optical imaging, mechanical displacement, electronic control, digital imaging, image analysis, computer processing, etc. to control the micro Vickers hardness tester and automatic stage through the computer host, and digitally image the hardness indentation on the computer screen, and then through automatic reading, manual reading and other means, accurately measure the microhardness, hardened layer depth, film thickness, two-point spacing, etc. of metal and some non-metallic materials, various films and coatings. It can also photograph metal surface morphology and print at fixed magnification. This system, which breaks through the traditional hardness testing method and realizes the full-automatic, high-precision and high repeatability hardness testing, is an important equipment for material analysis.

Features

- HVS-1000TA-XY digital display automatic turret micro Vickers hardness tester can display the results through the LCD screen, and can display and set the test scale, test force, indenter type, load holding time, conversion unit, etc.
- it adopts 8-inch touch screen and high-speed ARM processor, with intuitive display, friendly humancomputer interaction and simple operation; Fast operation speed, huge amount of database storage, automatic data correction, and provide data line report.

- The fuselage is cast by cast iron at one time, combined with the automobile paint baking process, with a round and beautiful appearance.
- The worm gear lifting system can better improve the test stability and test accuracy, and there is no need to focus again after the test.
- Equipped with automatic turret function, high-definition measurement and observation double objective lens combination, combined with high-definition micrometer eyepiece with built-in length encoder, it realizes one key measurement of indentation diagonal, and better reduces human operation interference and reading error.
- Convenient CNC system, which can automatically convert units of full hardness scale.
- The maximum and minimum hardness values can be set. When the test value exceeds the set range, a alarm buzzer will sound.
- It has the software hardness value correction function, which can directly correct the hardness value within a certain range.
- It has the database function to automatically save the test data in groups. Each group can save 10 data and more than 2000 data.
- It has hardness value curve display function to visually display the change of hardness value.
- Equipped with CCD image processing system. Knoop indenter for Knoop hardness measurement is optional.
- Equipped with wireless Bluetooth printer and output data through RS232 and USB interfaces.
- The accuracy shall comply with GB/T 4340.2-2018, ISO 6507-2 and ASTM E384.

Technical parameters

Vickers scale: HV0.01, HV0.025, HV0.05, HV0.1, HV0.2, HV0.3, HV0.5, HV1

Test force: 0.09807, 0.2542, 0.4903, 0.9807, 1.961, 2.942, 4.904, 9.807N

(10, 25, 50, 100, 200, 300, 500, 1000gf)

Test force selection: select the test force by rotating the test force conversion handwheel, and the current

test force is displayed on the screen

Loading control: automatic loading, dwelling, unloading

Load holding time: 1-99 seconds (1 second per increment)

Test mode: HV / HK

Hardness value: the hardness measuring range is 5-5000hv. The corresponding hardness value can be obtained by inputting the data measured on the micrometer into the hardness tester. Indication error is 3-5% HV.

Maximum height of test piece: 220mm

Distance from indentation center to machine wall: 130mm

Optical measurement system: Objective lens: 10 × (observation), 40 × (measurement)

Total magnification: $100 \times (observation)$, $400 \times (measurement)$ Measuring range: $200 \mu m$

Division value: 0.025 µ m

X-Y automatic stage: Table size: 130x120mm

Maximum travel: 50x50 mm

Minimum step length: less than 1 micron (0.001mm) (or 2 microns, optional)

Repeat positioning: less than 3 microns

Moving speed: adjustable

Control mode: manual control, electric control and computer control

Light source: 12V, 20W

Light source brightness: PWM dimming

Energy saving mode: automatically enter standby mode after 10 minutes' use

Power supply: 220V, 50Hz, Single Phase

Overall power consumption: 100W

Function introduction

- 1. The automatic recognition ability of diamond indentation image is significantly ahead of the existing mainstream hardness measurement software products.
- 2. Each functional area of the main interface can be dragged arbitrarily to form a personalized layout style.
- 3. Compatible with Knoop (HK) hardness measurement, Knoop Indentation can be automatically identified.
- 4. Besides automatic measurement, there are also three kinds of manual measurements: four point measurement, diagonal measurement and four side measurement.
- 5. Two calibration methods: hardness block calibration and optical calibration.
- 6. The calibration of standard hardness block supports multiple calibration and averaging.
- 7. The software will automatically select the best calibration coefficient for different resolutions, different objective lenses and different loads.
- 8. The best calibration coefficient is automatically selected according to different hardness values during hardness measurement.
- 9. During manual measurement, it has the function of magnifying glass, which is convenient to find the vertex position of indentation.
- 10. The indenter / lens offset calibration function is provided to eliminate the mechanical deviation between the indenter and lens and correct the overall system error, so as to improve the accuracy of hardness test results.
- 11. Support a variety of video capture devices, with a resolution of 1.3 million, 2 million, 3 million and 5 million digital cameras. Display the indentation video on the computer to capture and store images.
- 12. When measuring the hardened layer path sequence, there are many flexible initialization setting modes, which automatically save and import the previous path sequence. The measurement path can also be saved arbitrarily for reloading.

- 13. The measurement results are arranged according to the path sequence, and the corresponding hardened layer depth value and hardness change curve are generated.
- 14. It provides distance measurement and angle measurement functions, and can display multiple groups of distances and angles on video or images at the same time.
- 15. Built in hardness value conversion tools for various standards, with reference to GB, DIN, ISO, ASTM and other standards, it can achieve mutual hardness conversion between Vickers HV, Knoop HK, Rockwell: HRC, HRA, HRB, HRD, etc., Superficial Rockwell: HR15N, HR30N, HR15T, etc., Brinell: HBS, HBW, etc. Any conversion unit can be selected and listed in the result table.
- 16. Report content and format can be set flexibly, and word and EXCEL documents can be generated automatically. All results, indentation images, user-defined information lists, and user logos can be set to generate graphic reports.
- 17. Password and management authority can be set: ordinary operators can only measure hardness according to the set settings.
- 18. The software can automatically save the user's habitual settings, and keep the state of the last shutdown when it is next started.
- 19. The software is available in Chinese, English, German, Spanish and Russian (optional).
- 20. Hardness tester turret automatic control function.
- 21. Path planning function, 17 kinds of path planning can be set freely.
- 22. Area mode & continuous printing and testing function. For multiple indentations that may exist in the same field of view, the area mode can be selected. Only the indentations within the set range are considered during each measurement. When the area mode is enabled during the continuous test, the test interruption caused by multiple indentations in the same field of view can be avoided.
- 23. The surface correction function conforms to Table I and Table II of ASTM E384 standard, and provides the test and correction requirements of ball, rod and other surface parts.
- 24. During Knoop automatic identification and measurement, the indenter angle correction can be input, ASTM E384-11, SEC 10.7.2.1.
- 25. For the Vickers and Knoop measurement results, the effectiveness alarm function is introduced for the suspicious shape indentation that does not meet the ASTM E384 standard.
- 26. Multi sample panoramic scanning function, which can perform panoramic scanning on multiple samples, then make path planning on the panorama, and finally complete continuous printing and testing.
- 27. The scanning area can be set freely. For irregular samples, the scanning area can be set according to the shape to reduce the scanning area and improve work efficiency.
- 28. The CHD hardened layer test function can set stop conditions as required. When the test conditions are met, the test process will be interrupted in advance. The original purpose of this function is to save time after the CHD test reaches the limit of the hardened layer.
- 29. The calibration adopts the evaluation of error and repeatability to ensure that the calibration is qualified.
- 30. The automatic brightness function can automatically adjust the surface of the sample to the best

state. The appropriate brightness can better distinguish the indentation from the surrounding, and help to identify the indentation vertex more accurately.

- 31. The minimum interval generates test points, which can obtain more detailed and accurate hardness distribution of the sample.
- 32. The built-in predetermined denture template can greatly save the setting time for complex and timeconsuming test points, especially for the measurement points of the toothed flank. All standard presets such as HK30 and HK0.5 can be implemented in one device. The corresponding reports are also stored.
- 33. Fracture toughness: the system allows the user to continue to measure the crack size after measuring the normal hardness indentation (click the left, right, up and down extremes of the crack with the mouse) to calculate the fracture toughness. The system displays three more columns in the hardness measurement result table: C1, C2 and KIC. C1 is the distance from the leftmost to the rightmost end of the crack (unit: mm), C2 is the distance from the top to the bottom, the total crack length L = C1+C2-D1-D2 (D1 and D2 are the measured diagonal length of the indentation), the fracture toughness is calculated according to KIC = 0.0028 * sqrt (HV * F/L), HV is the measured hardness indentation, F is the test force unit: N, the unit of L is m, KIC unit: MPa m^1/2. Different calculation methods will be provided later. Like the indentation, the crack size will have a rectangular mark. The user can drag the mouse to modify any side of the rectangle, and the calculation result statistics column. If it is checked, the statistical result will be fracture toughness KIC. If it is not checked, it will be HV. The report (WORD and EXCEL) will automatically add C1, C2 and KIC columns. Note: when the fracture toughness is selected, the Knoop hardness above shall not be selected.



Hardness measurement (automatic measurement)



- 1. Before measurement, it is necessary to ensure that the "pressure selection" value is consistent with the equipment test force. The diagonal of the diamond indentation shall be in the horizontal and vertical directions of the screen as far as possible, similar to the following figure.
- 2. Click "automatic measurement", the HDS system will automatically perform image recognition and measurement, and display the results. If multiple indentations are automatically measured, the indentation area can be displayed in the "area selection" box, and then click "automatic measurement". The measurement results are displayed in the measurement progress in the lower left corner and automatically added to the measurement results list.
- 3. If the vertex error marked by "automatic measurement" is large, press and hold the "shift" key (click "manual measurement" to turn blue and enter the manual state), click the Red Cross with large error (turn light green), move and click the actual vertex position, or use the keyboard "a/d/w/s" (representing left, right, up and down respectively) to fine tune, and then release the "shift" key.
- 4. Manual measurement: for unclear indentation images, three "manual measurement" methods are provided: "four point measurement", "diagonal measurement" and "four side measurement". Right click "current image" to switch and select in the following window.
 - a) Four point measurement: click the four vertices of the indentation.
 - b) Diagonal measurement: click twice to form a box that just frames the four vertices of the indentation.
 - c) Four side measurement: two vertical lines and two horizontal lines intersect with the vertex of the indentation respectively.
- 5. The system provides two indentation marking forms. You can right-click to select four "Red Cross" or "rectangular box" forms.
- 6. In the right-click menu "display content setting", the text information of the measurement results can

be displayed on the image.

7. After the "automatic measurement" is completed, click near the Red Cross to automatically enter the "manual measurement" mode

Measurement path

Before multi-point measurement, please edit the position of each point under "measurement path", and you can set the coordinate value for measuring the depth hardness curve.

In the right-click menu, you can click the "insert before" and "insert after" buttons to add positions before and after the current line. The current position can be modified by clicking the "modify" button or deleted by clicking the "delete" button.

For users who have detected the same indentation line for a long time, the user can choose to click the "save" button, and the system will save the settings in the computer. The next time you need to test, click the "import" button, read out the last saved file, and then load the original settings.

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New path: you can right-click "new" to build an equidistant measurement path point set in any direction. The interface is as shown in the following figure. After setting "starting point coordinates", "point spacing" and "points", click "add" to add a group of points to the list. "Connect previous line" means that the settings of this group of points are consistent with the previous group of points. After clicking the "OK" button, the measurement path composed of a series of points can be generated according to the settings of the new path points.

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Multi-point measurement

- 1. If you need multi-point measurement, edit the position of each point under "measurement path".
- 2. When measuring multiple points, you can still delete, re measure and insert new measurement points at any time in the "measurement results".
- 3. Click the "data analysis" button in the "measurement results" to display the statistical information of all current measurement results.
- 4. When the number of measured points is equal to the number of measurement path points, the system automatically prompts to save the measurement report. If you choose to continue the measurement, record the measurement results without path information.
- 5. Content setting: click "content setting" to open the interface as shown in the following figure, and select the column name to be displayed. After clicking "OK", relevant contents will be listed in the measurement result list according to the selected column name. In the latter part, the measured hardness value is converted to other hardness measurement units, and the conversion standard referred to is from the settings in "Hardness Conversion".









Path planning function

As an extension of the measurement function, the "measurement path" page provides 8 ways to complete the accurate planning of the path to be measured by clicking the image with the mouse.

Path planning	Basic function	
Free point selection	Click any position of the image to become the path to be measured.	
Any direction	ection Click any starting point and line segment in any direction.	
Edge normal Click near the edge to automatically generate normal line segmen		
Two point normal Click the two ends of the edge to generate the central normal line se		
Angular bisector	ngular bisector Three points construct angles to generate angle bisector segments.	
Arc path	Two points are used to determine the center / radius of the circle and generate	
	the path in time.	
Edge profile	Click near the edge to automatically generate a path along the edge.	
Edge isometric	Click the distance along the edge to generate equidistant line segments.	
Sawtooth waveform	The period, tooth height and tooth symmetry can be set quantitatively.	
Two point center	Click any two points to determine the center of the two points	

Path planning	Advanced features	
Line	Select any starting point, line segment in any direction, and variable distance	
	in the middle	
Multi-lines	Multiline path points	
Sawtooth	Jagged multiline	
Interpolation	blation Insert a fixed number / distance of path points between two points	
Matrix	Path points for rectangular arrays	
Wheel	Wheel path point	
Ring	Circular path point	

There are four ways to add the planned path in the image to a line of the measurement path.

- ① Add after original line: add a new path after the original line segment
- 2 Delete the original line and create a new line: delete the original line segment and create a new line segment.





X-Y stage control

With the help of A8810 high-precision XY automatic table, it can achieve:

1	Single stop orientation	Front, back, left, right and bisector direction, single step		
1.	Single step onentation	length determination.		
2.	Positioning movement	The center of the indentation is moved to the set xy/ polar		
	Positioning movement	coordinates.		
3.	Fixed point movement	Move the indentation center to the current point.		
4.	Arbitrary drag	Drag the arrow to move in the direction indicated.		
5.	Continuous testing	Program the measurement operation in the order of the		
		measurement path.		
6	Edge scan	Automatically find the edge of workpiece surface and		
0.		generate contour.		
		It supports the setting of specified coordinates,		
7.	Scanning range setting	rectangular vertices and multilateral vertex scanning		
		range.		
8.	Panoramic scan	Set scanning area and mosaic area panorama.		
	Multi sample panoramic	Set the scanning area on multiple samples and splice the		
9.	scanning	panoramic view of multiple sample areas.		

Panoramic scan

Select the "set scanning range" function under "panoramic scanning", and on the "set panoramic scanning range" interface as shown in the following figure, select the way to set the scanning range (specify coordinates, rectangular vertices, multilateral vertices) and the motion way (precision first, speed first). Scan range vertex setting when selecting rectangular vertices or multilateral vertices, please go to the current video window to select vertices according to the prompts, and then click "OK" to complete the scan range setting. If the range is not set according to the prompt in the current video window, close the "set panoramic scanning range" window and prompt the following window. At this time, the user needs to set the scanning range first.





Select the "scan current sample" function under "panoramic scanning" to start the scanning process of the panorama of the current sample.

The right-click menu of the software interface provides functions such as moving to the point, displaying the path, deleting the selected path point, importing the current image, saving the image, etc.

The lower part of the interface is provided with zoom display function, which can reduce the display when the picture is too large.

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Set the scanning range of 20×15 mm for the coin on the XY automatic platform for panoramic scanning. The HDS system controls the motor movement and captures the camera with a resolution of 640 × 512. In the end, more than 2500 pictures will be connected to the effect pictures shown on the next page.



Precautions:

- 1. When using the function of controlling the movement of the platform according to the image, the system needs to be optically calibrated in advance.
- 2. The workpiece shall be placed within the movable range of the platform.

Freely set scanning area

Freely set the scanning area function. For irregular samples, the scanning area can be set according to the sample shape to narrow the scanning range, so as to save scanning time and improve work efficiency.



Schematic diagram of point setting in scanning area:

Just under the scanning objective lens, directly select the approximate positions of the above red dots in turn to form a route containing the area of interest. Area point setting word scan effect

Multi sample panoramic scanning

Multiple samples can be scanned at one time to obtain multiple panoramas. First, name the sample. Refer to section 4.6 for the setting of multi sample name. Then select the name of the sample to set the scanning range. In the current video window, drag the selected sample and set the scanning range. The setting method refers to section 6.8. The setting method of other samples is the same as the first operation method. After setting the scanning range of all samples, click the "scan all samples" function under "panoramic scanning", Start scanning panorama of all samples.



Path planning operation on panoramic image: click "import to current image" to import the image content displayed on the current panoramic image interface into "current image", and carry out path planning related operations in "current image" according to the operation instructions of path planning function. (see the introduction in part 5 for path planning)





X-Y stage