

Digital Vickers Hardness Tester

MODEL ISH-DV50

# **USER'S MANUAL**

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## I. General Description

VICKER'S Hardness Tester with Digital Display is a new hi-tech product integrating mechanical and photoelectrical technologies. As a substitute of traditional small-load Vicker's hardness tester, it features in easy operation and good reliability.

The following highlight some key features and functions:

- Integration of computer programming technology, high resolution optical measuring system and photoelectrical technique;
- Soft key input;
- Light source adjustment;
- Selectable testing model, conversion tables, pressure-holding time, file number input and data saving functions;
- Big LCD screen to display testing model, testing pressure, indentation length, hardness values, pressure holding time and numbers of tests;
- Date recording, test results recording and data processing;
- Printing output function;
- RS232 interface for PC connection.
- Camera for indentation photographing and metallography

The tester is specially designed for testing minute, thin samples or parts after surface coating. For research institutes, factories labs and QC departments, this is an ideal hardness testing instrument for research or measuring purposes.

## II. Main Specifications

Testing Pressure	9.8N(1kgf), 49N (5kgf) 98N(10kgf), 196N (20kgf) 294N(30kgf), 490N (50kgf)
Hardness Value Symbol	Error Range in Display
HV <sub>1</sub> , HV <sub>5</sub> , HV <sub>10</sub> HV <sub>20</sub>	±3.0%
HV <sub>30</sub> HV <sub>50</sub>	±2.0%
Hardness Value Range In Measure	5HV <sub>1</sub> ~2500HV <sub>50</sub>
Pressure Loading & Unloading	Automatic
Magnification of Microscope	100 x (for measuring)
Pressure Holding Time	0 ~60 s (1 second as input increment)
Minimum Measurable Unit	0.125 μm
Maximum Height of Sample	160mm
Distance from Indenter's Center to Outer Wall	135mm
Main Body Weight	approx. 40kg
Power Source	AC220V/50Hz
Machine Size (LxWxH)	(540x220x650)mm

## III. Installation and Commissioning

### 1. Working Conditions:

- a) Under room temperature between 10~35°C
- b) Installed and leveled on a stable base
- c) Placed in an environment free of vibration
- d) Placed in an environment free of corrosive medium
- e) Relative humidity not exceeding 65%

### 2. Unpacking & Installation

- 2.1 Remove the packing box and take out the main machine and accessory box.
- 2.2 Place the tester on a dedicated working table;
- 2.3 Take out the leveling screws out of the accessory box and fix them at the bottom of the main body . Adjust the screws until the body is leveled.

2.4 Lower the lifting screw and remove the filling piece between the lifting screw and the indenter cap. Turn the handwheel further and make sure that the lifting screw can freely turns within the hole on the working table. For the size of the hole to be opened on the table, please refer to the following drawing:

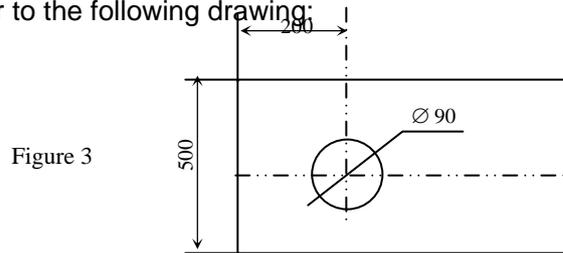


Figure 3

2.5 Remove the gauze between machine top and indenter. Open the top cover and remove the gauze which fastens the cam and lever. Then replace the top cover.

2.6 Open back cover and remove the gauze fastening the hanger and support. Get weights from accessory box and install them in an order with Weight No.1 on the top. Then replace the back cover.

2.7 Plug the power cord and turn on the switch. The tester is now ready for operation.

### 3. Operation Panel & Menus

#### 3.1 Key Functions (Figure 4)

4 ESC	5 PRI	6 ↑	7 DEL	8 L +	9 DISP
0 CLR	1 ←	2 ↓	3 →	• L -	ENTER START

Figure 4

3.1.1 Number Keys: Keys with 0,1,2.....as the 1<sup>st</sup> function

3.1.2 Function Keys: (mainly 2<sup>nd</sup> function keys)



Exit to main menu



1<sup>st</sup> function: confirm 2<sup>nd</sup> function: start



Direction keys



Printing out current data or saved data



Delete data of current test (including current number of tests)



Display data for current test



Clear



Increase brightness of light source



Decrease brightness of light source

Adjusting light source in testing

To maximize ease in operation, the software is so designed that no shift key is required between 1<sup>st</sup> and 2<sup>nd</sup> function conversion. Num keys become valid only when you are requested to input numbers. Function keys are the main effective keys in working.

### 3.2. The Menus

Turn on the machine and the indicator on the left side of the printer lights up. After several beeps, the screen appears like Figure 5. The Main Screen adopts the most common menu format and interactive dialogue window format, and is thus very user-friendly.

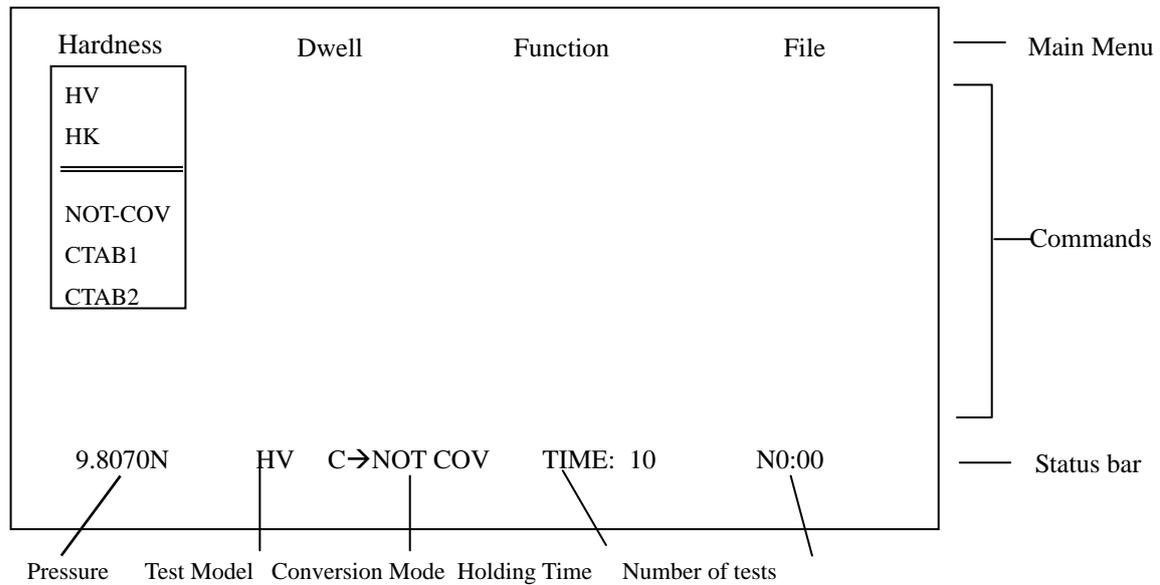


Figure 5

Scroll the highlighted bar through drop-down submenus and press [ENTER/START] to confirm. For example, to select HV command, you scroll the highlighted bar by pressing [6/↑] [2/↓] until HV is highlighted. Then press [ENTER/START] to confirm.

For all correct operation, a beep follows each key press. A prolonged buzz will give off in case of any error in key pressing.

Normally, the motor is load relieved when the tester is turned off and screen shows as Figure 5 when the tester is turned on again. If the buzz goes off and stays on as soon as the machine is turned on, then the motor is not yet loaded relieved. Wait until it is load relieved and the buzz will stop. Only then can operation be conducted on the tester.

#### 3.2.1 Status Bar

The first item is the indication of pressure, which can be selected by Pressure Change Handwheel. The user can select the required pressure from 6 load steps from 2.94N to 98N. The selected pressure will be displayed on the status bar.

For example, Figure 5 shows that the current pressure is 9.8070N. If we want to change the pressure to 4.9035N, just turn the handwheel to 4.9035N and the display will change accordingly on the status bar.

The second item shown on the status bar is test model: HV or HK.

The third item is conversion mode and C→NOT COV (as shown in Figure 5) means no conversion.

The fourth item is pressure holding time which is now 10 seconds as shown in Figure 5.

The last item is number of tests.

### 3.2.2 Main Menu

#### 3.2.2.1 MODEL ..... Selection of test model

The items contained in the submenu includes:

- HV \_\_\_\_\_ Test model of Vicker's Hardness
- HK \_\_\_\_\_ Test model of Knoop's Hardness
- NOT-COV \_\_\_\_\_ No conversion
- CTAB1 \_\_\_\_\_ Nonferrous metal conversion table (Figure 6)
- CTAB2 \_\_\_\_\_ Ferrous metal conversion table (Figure 7)

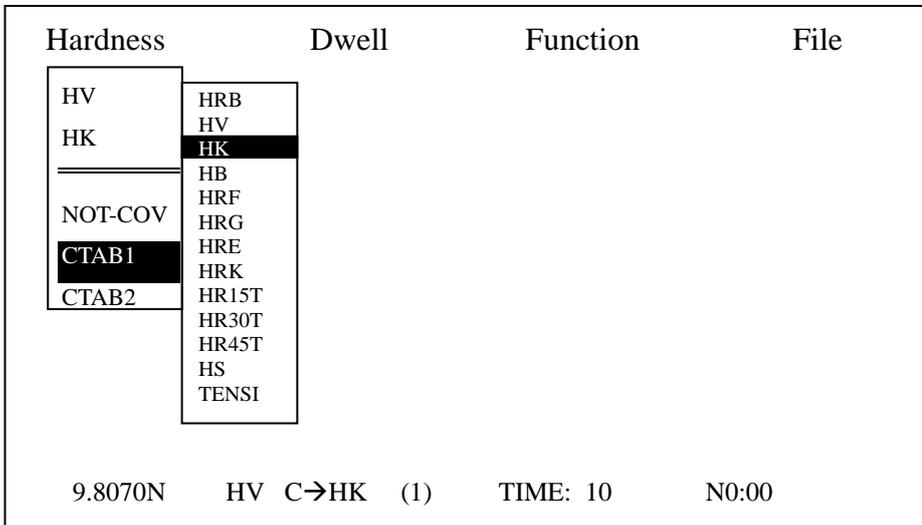


Figure 6

Select HV or HK by pressing the direction keys on the control panel and confirm by ENTER. Press direction keys again until CATB1 is highlighted. Confirm and CATB1 will pop out a sub menu which displays conversion tables for nonferrous metals. Select one conversion scale and confirm again. When these steps are completed, the status bar will automatically display the conversion model you have set. In Figure 6, the status bar displays HV C→HK which means conversion from Vicker's hardness into Knoop's hardness. The indication of "(1)" on the right side indicates that conversion table for nonferrous metals is currently selected.

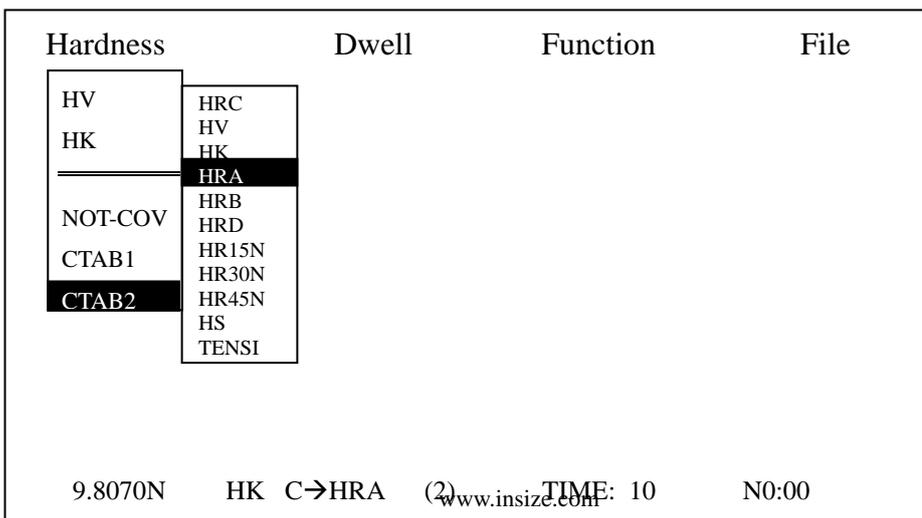


Figure 7

Select HV or HK by pressing the direction keys on the control panel and confirm by ENTER. Press direction key again until CATB2 is highlighted. Confirm and CATB2 will pop out a sub menu which displays conversion tables for ferrous metals. Select one conversion scale and confirm again. When these steps are completed, the status bar will automatically display the conversion model you have set. In Figure 7, the status bar displays HK C→HRA which means conversion from Knoop's hardness into Vicker's hardness. The indication of "(2)" on the right side shows that conversion table for ferrous metals is currently selected.

### 3.2.2.2 DWELL..... Pressure holding time (in seconds)

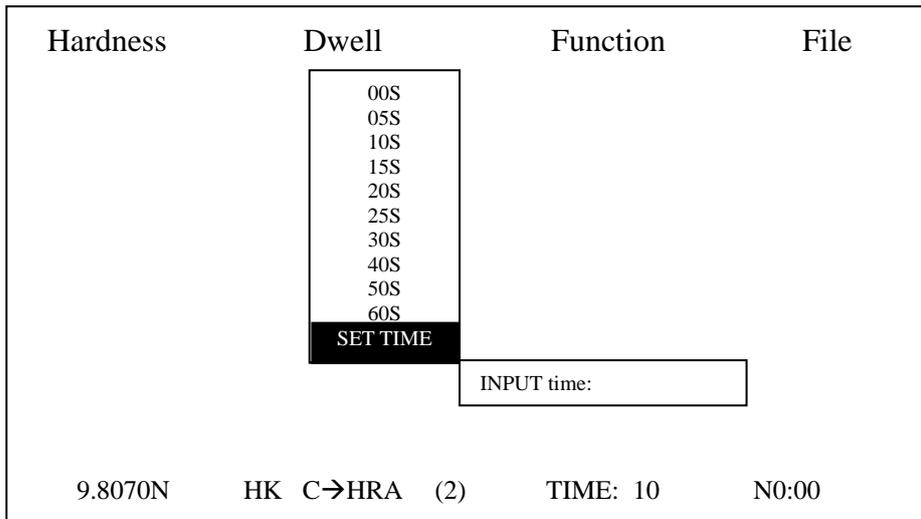


Figure 8

As shown in Figure 8, the pressure holding time can be selected from 10 choices from 0 second to 60 seconds. Toggle through the required holding time and confirm by ENTER. If the required time is not available in the set range, select SET TIME command and a dialogue box appears on the screen. You can input any time from 0 to 99 seconds and confirm. Your selection or input will then be displayed on the status bar.

### 3.2.2.3 Function ..... Function key

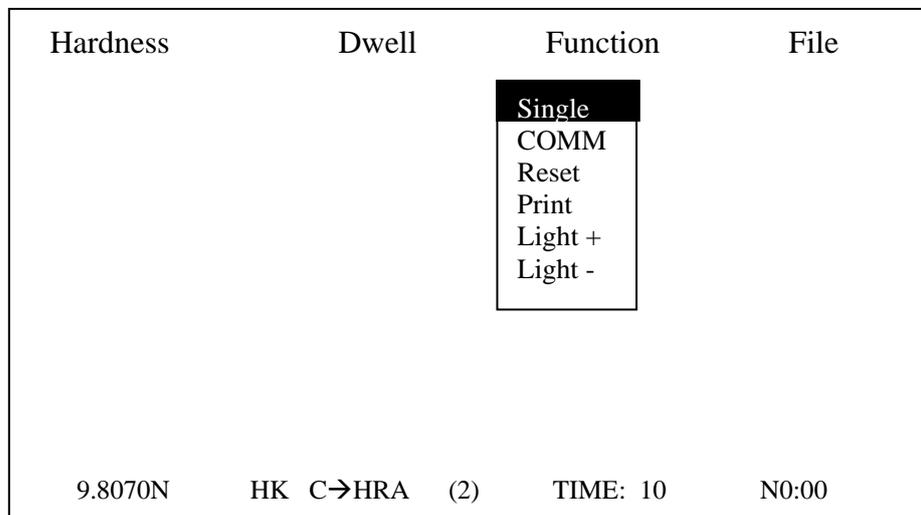


Figure 9

Single machine operation is similar to that of other ordinary hardness testers because operation is done through the internal mechanism and electronic features without connection with any external equipment (i.e. external PC).

Use direction keys to select Single and confirm by ENTER key. Screen as Figure 8 will change into single machine operation screen as shown in Figure 9.

### 3.2.2.3.1 Single..... Single Machine Operation

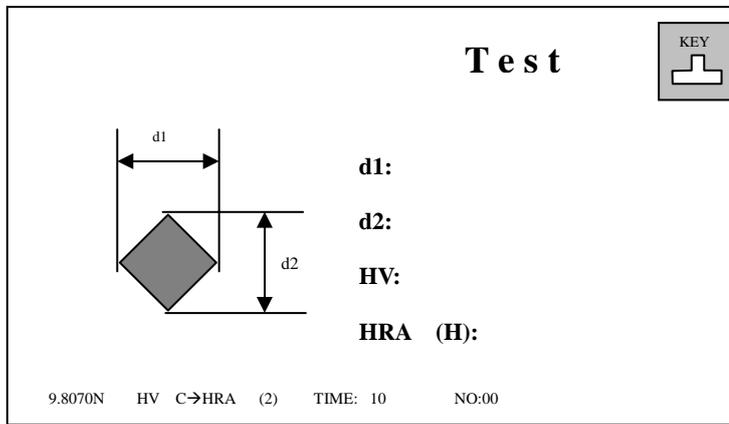
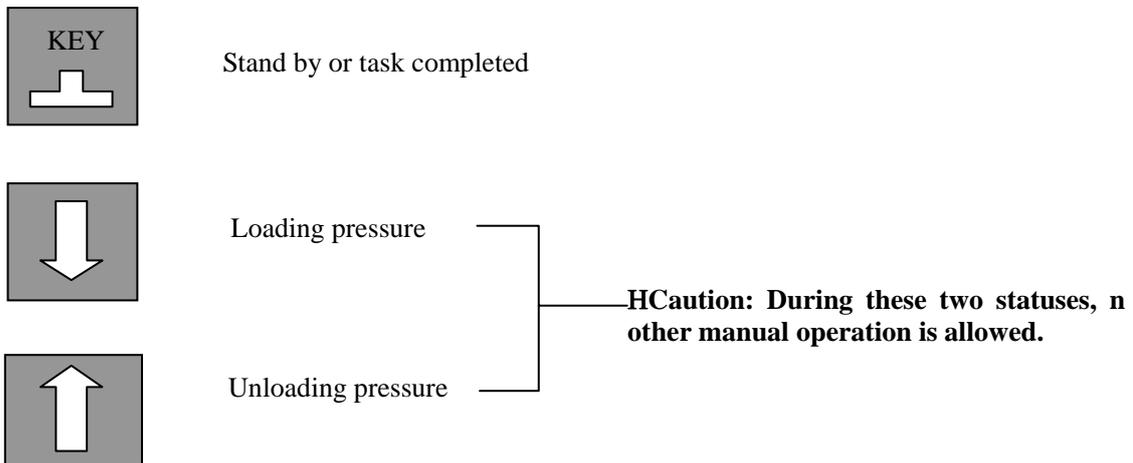


Figure 10

Figure 10 shows the single machine operation of the Vicker's hardness tester.  $d_1$  and  $d_2$  are the two diagonals of the indentation which are measured by photoelectrical encoder. HV is the Vicker's hardness value and is automatically displayed as soon as  $d_1$  and  $d_2$  are measured. HRA is the conversion scale which can be set as shown in Figure 6 or Figure 7. Similarly, other scales can also be set through conversion tables. If no conversion scale is selected, the status bar will display HV C→NOT COV. In this case, only  $d_1$ ,  $d_2$  and HV are displayed under the heading of Testing and no conversion scale is displayed. KEY stands for working status which has 3 modes:



In doing Knoop's hardness testing, the testing procedure requires the measuring of  $d$ . Other procedure and status remains similar to that of Vicker's hardness testing (as shown in Figure 11).

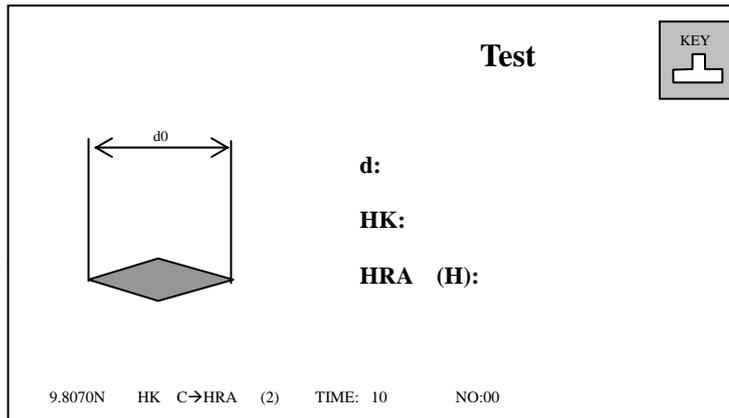


Figure 11

### 3.2.2.3.2 COMM ..... PC connection

This function allows the machine to be connected to a PC via RS232 interface and thus offers the possibility in the development of new CCD hardness testers by either the manufacturer or the user.

### 3.2.2.3.3 Reset ..... Reset operation

Reset function is effective to the current testing data. Please note that, while testing one sample after another, the reset command will cause the loss of the previous testing data. So, please decide whether or not the previous data should be saved. For information regarding data saving, please refer to Save command hereinafter.

However, testing one sample after another without reset will cause the previous results to be mixed into the current data and data confusion and miscalculation will occur.

In case of no saving is necessary, use reset function freely.

### 3.2.2.3.4 Print ..... Printing function

This function allows the printing of current testing data.

### 3.2.2.3.5 Light + .....Increase the brightness of the light source

### 3.2.2.3.6 Light - .....Decrease the brightness of the light source

Light + and Light – are used to adjust the brightness while the tester is not in testing status. Select the command and press ENTER to confirm. Then you will hear a beep every time you press the ENTER key, indicating that the brightness is increasing or decreasing. When you hear a continuous beep, the brightness is either maximized or minimized.

### 3.2.2.4 FILE ..... File functions

#### 3.2.2.4.1 Save ..... Saving files

This function allows you to store the current testing data in a file. There can be as many as 28 files to store, numbered from 00 to 27. If you continue saving a file when 28 files are already in store, the first file will be automatically deleted. (i.e. File 00 will disappear and the

files will be stored in the order from 1 to 28.) New files are stored according to their number sequence.

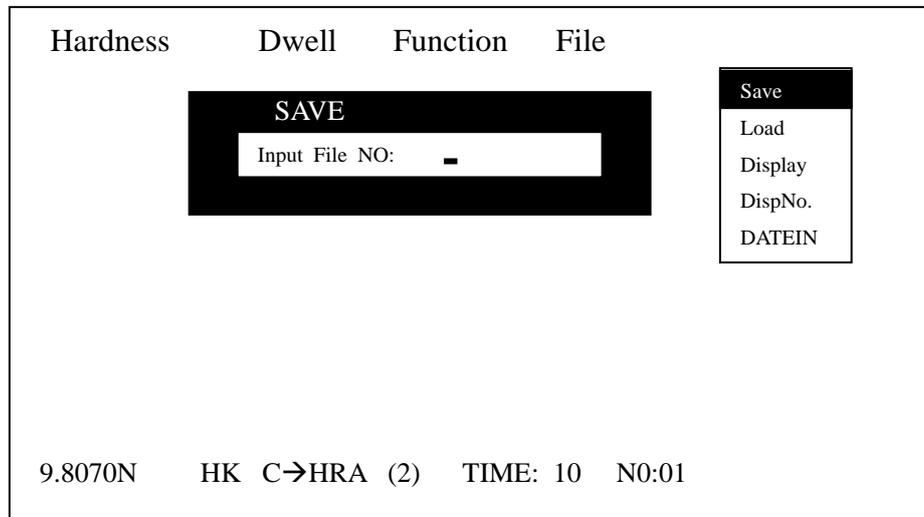


Figure 12

As shown in Figure 12, a dialogue box will pop up when SAVE function is selected and you need to input the file number. Please note that file number is input through num keys and must contain 6 digits, which can be randomly decided by you. If the input number is the same as one file number already in store, a warning will be given and the machine will ask if you need to replace the old file. Press 0 for no and 1 for yes. Please see Figure 13 as an example.

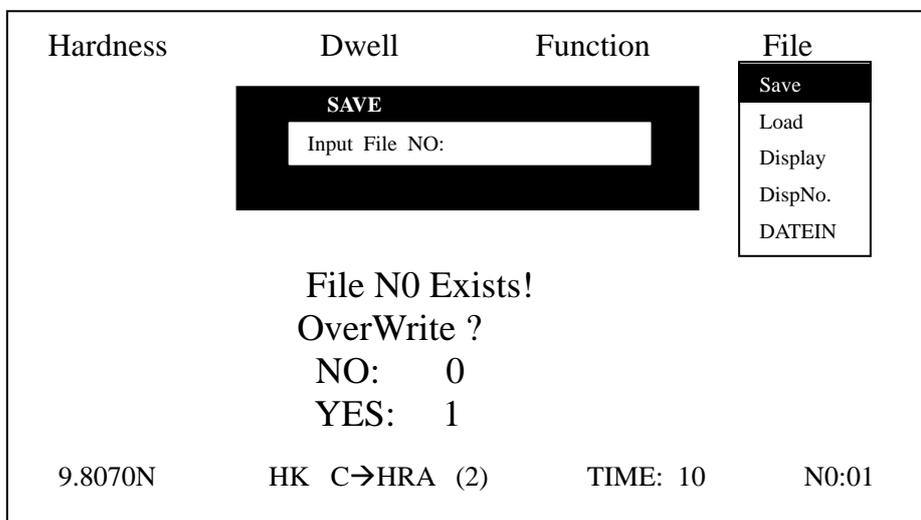


Figure 13

#### 3.2.2.4.2 Load ..... Open file

This function is used to open the stored files and display the content on the screen.

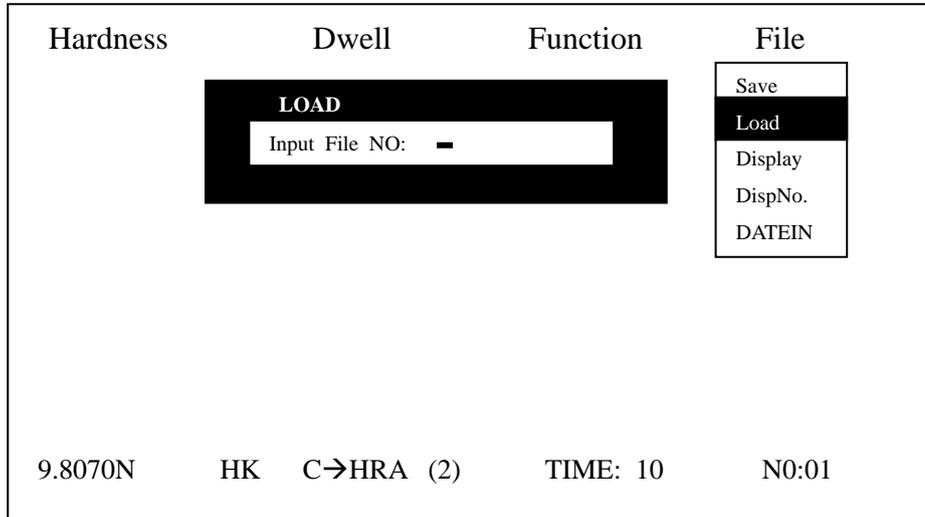


Figure 14

As shown in Figure 14, a dialogue box will pop up when Load is selected and you can then input the file number, which must be one of the file numbers already in store. When a wrong number is input, the screen will display “file not found”. Screen page as Figure 14 will appear again, waiting for re-input. If the correct file number is input, the display changes into the screen as shown in Figure 15 (demo display only) .

No	D1(um)	D2(um)	HV	HRC (H)
01	48.313	48.313	48.313	794

9.8070N      HV NO: 02 1111111      TIME: 10      NO:01

Figure 15

In the heading, No stands for number of tests while d1 and d2 the diagonals for measuring. HV is the hardness value. The first No indication on the status bar contains 2 digits: the first being the sequential number of the current file among all stored files while the second being the actual file number for retrieving. The second NO indication on the status bar means the

number of current tests. This tester can display testing data for as many as 19 tests. In addition, we can use direction key “↓” to see statistic results of the testing data (Figure 16). DD stands for error repeatability, MAX for maximum value, MIN for minimum value and AVE for average.

DATE	AMOUNT
DD=0.00%	
MAX=794	
MIN=794	
AVE=794	
9.8070N	HV NO: 02 1111111 TIME: 10 NO:01

Figure 16

3.2.2.4.3 Dispsll ..... Display all data in store

When this function is selected, you can use ↑, ↓ keys to go through all data in one file. Or, you can use →, ← keys to go through all files. In the latter case, every press of the direction key will increase or decrease the file number by 1. All the files are automatically stored in number order when you save them.

3.2.2.4.4 DispNO. .... Display the file numbers in store (Figure 17)

This function allows you to refer to the numbers of all files in store.

NO.	DISP
00	111111
01	222222
02	000000

Figure 17

3.2.2.4.5 DATEIN ..... Set the date for file saving

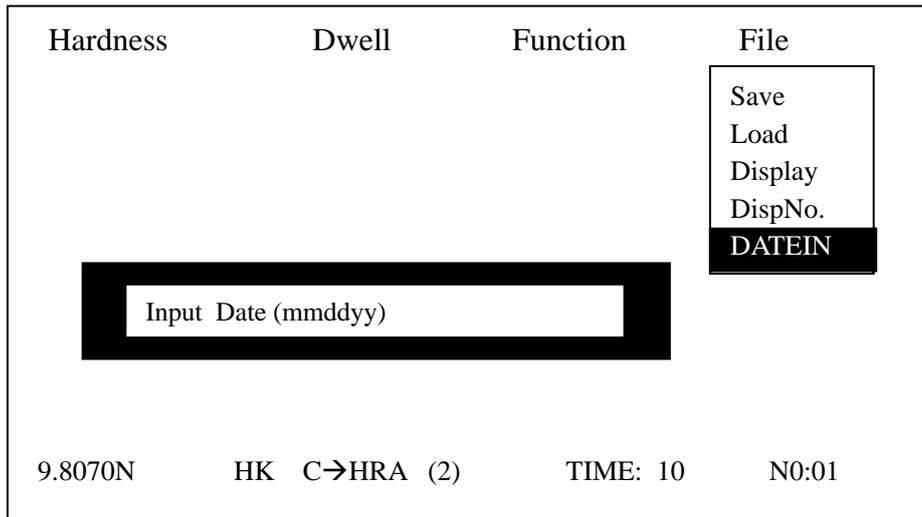


Figure 18

As shown in Figure 18, a dialogue box will pop up when you select DATEIN function, waiting for your input of date. Press the num keys to input the date in order of month, day and year. The date must be input before you save the file because the date will not be saved together with the file if you save the file before you input the date.

#### 4. How to Operate

The switch panel is located on the right side of the machine. It has the power switch, RS232 interface, fuse seat and power socket. The RS232 interface enables communication with periphery equipment. The fuse is of 1A/250V and serves the main electric circuit.

Find the power cord in the accessory box and plug it into the power socket as shown in Figure 19.

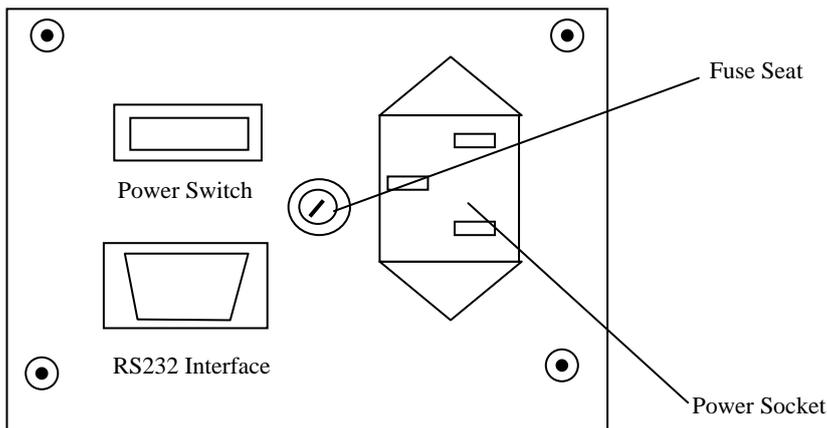


Figure 19

- 4.2 Turn on the power switch and the screen lights. Turn testing pressure change handwheel to select the required testing pressure. Make sure that the loaded pressure is the same as that shown on the screen. The wrong display will result in the wrong calculation. Gently turn the handwheel to avoid impact damage. (See Figure 5 for reference display).
- 4.3 Then the screen will show the submenu under MODEL . Under MODEL heading there are 2 testing model options: HV (Vicker's ) and HK (Knoop's). Press ↑, ↓ keys to highlight the desired model and confirm by ENTER key. Meantime, you will see HV or HK is displayed

on the status bar on the screen (See Figure 5 for reference display).

There are two hardness conversion tables following NOT→COV: CTAB1 and CTAB2. CTAB1 is used for nonferrous metal while CTAB2 for ferrous metal. Select the desired table by ↑, ↓ keys and confirm with ENTER key. After the conversion tables are displayed (Figure 6 and 7), use direction keys to highlight the desired table and confirm by ENTER key. The selected hardness conversion scale will be displayed on the status bar then.

- 4.4 Press → key and the sub-menu under DWELL will pop out, which is for selecting pressure holding time. There are 10 options from 00S to 60S and you can make your selection by highlighting the desired time and confirming with ENTER. If you need to set the time in the range of 0~99S, use direction keys to highlight SETTIME and confirm by ENTER. Then an "INPUT time" prompt will appear on the screen and you may set the time with num keys. (Note: Two digits are required in time input, e.g. 03 for 3S) Confirm your input by ENTER key and the set time will appear on the status bar (as shown Figure 8).
- 4.5 Press → key and the submenu under FUNCTION will pop out, showing Single, COMM, Reset, Print, Light + and Light – as the options. Light + and Light – are used to adjust the brightness of light source in stand by mode. To increase or decrease the brightness, highlight Light + or Light – and press ENTER. Each time you press ENTER, the brightness is increased or decreased once. Keep pressing until the image is clear.

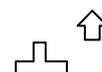
Reset is used to clear the current testing data. Please note that in single machine operation mode, the reset key will cause loss of the testing data of the current sample when you press reset to test another sample. So please make it sure whether you want to save the current data. If not, press Esc to return to main menu. Then select and confirm Reset function. If yes, return to main menu and select Save to store the file. In saving, input the 6-digit file number by num keys and confirm by ENTER. When the current data is saved, select and confirm Reset. Please note that the current data will cause calculation confusion in the next test if it is not reset.

Select Print function to print out current testing data.

COMM is provided for communication with periphery equipment.

Select Single to enter working mode. Use direction keys to highlight this function and confirm by ENTER. Then you will see display on the screen as Figure 10.

- 4.6 Turn the Indenter-Objective changing wheel, moving 10<sup>X</sup> Objective to the front of the main body (optical magnification 100<sup>X</sup> in measuring mode).
- 4.7 Place the standard sample on the testing table right under the Objective. Turn the Revolving Wheel (20) and the testing table rises. While the sample is getting closer to the lower part of Objective, you may watch through the Micro Eyepiece. If the image gets brighter when the table rises, then you will know that it is focusing in. Turn the handwheel more gently until the image of the testing sample (or the sample surface) becomes sharply distinctive. Now the tester is focused.
- 4.8 Maybe the image you see is still fuzzy, then you may adjust the front lens of the Eyepiece until you see a sharp image (because the observers' eyesight varies). If the testing surface you see in the eyepiece is not evenly lighted, you may adjust 3 screws on the light source device until it is centered. If the image gets too bright or too dark, press L +, L - keys on the panel to adjust.
- 4.9 Turn the indenter-Objective change wheel until indenter spindle comes to the front. Press START key on the panel and the machine starts pressure loading. You will see a  being displayed in the upper right corner of the screen, which indicating pressure loading



process. As soon as it completes loading, the machine starts pressure holding status. You will see a countdown indicator shown in a box in the screen's upper right corner. As soon as the holding time is up, a      appears in the screen's upper right corner, indicating the pressure unloading process. A      appears in the upper right corner of the screen when the unloading ends. The current testing is completed then.

Note: ⚠ If the sample has a rugged surface or has multi facets, be careful when you move the indenter, lest it hits the sample.

⚠ In case you forget to change the objective and you press START or the machine starts working, DO NOT turn the Indenter-Objective change wheel. You have to wait until the current test is completed. Otherwise, the machine will be SERIOUSLY DAMAGED.

- 4.10 Turn the Indenter-Objective change wheel and move 10<sup>X</sup> Objective to the front. Observe the image through the Eyepiece and adjust lifting screw to obtain a sharp image. Please note that under the objective of 100<sup>X</sup> magnification, the depth of the indentation may affect the focal plane. But this is normal.
- 4.11 Move the scale marks of the Eyepiece towards each other. When the marks are closing to the critical moment when light is just to be shut out, press CLR key on the panel and the screen shows d1: 0, which is the so-called zero place.
- 4.12 Turn the handwheel on the right side of the eyepiece to move apart the scale marks. Then turn the knob on the left side of the Eyepiece to move the left mark. When the inner side of the left mark touches the intersection point to the furthest left of the indentation, start moving the right mark until its inner side touches the intersection point to the furthest right of the indentation. Press the testing button on the Eyepiece and the screen will display the current testing data and the hardness value after conversion. If you are not sure about the accuracy, repeat the testing procedure as described above.
- 4.13 Only after the first test (measuring) is done can you start next. The testing and measuring procedure stipulates that the first indentation will not be taken into recording. So, the hardness value obtained in the measuring of the second indentation will be recorded as the first result. Then you will find that NO:00 changes to NO:01 on the Status Bar.
- 4.14 As only 60% of the vision observed through the Eyepiece is valid, the loaded pressure needs to be reduced when the image of the indentation appears too big. Otherwise, error will occur to the measured result. If the indentation you see through the Eyepiece is too small, you may increase the pressure to enhance the measuring accuracy. (Note: The load must not exceed allowed limit. Otherwise, the sample may be punched through.)
- 4.15 After several tests, if you need to check previous test data, press DISP key and the required data and statistical results will appear on the screen. Then press ESC to resume working status. Press START key and the machine will start the next testing procedure.
- 4.16 There are two printing functions available. The first printing command in the FUNCTION menu will print out the current testing data. But it does not allow the printing of stored files and data obtained in tests other than the current one (The "current test" refers to the test provided that no change is made to pressure, no new file opened and no change in menu selection.). 19 groups of data can be printed out in maximum.  
  
The second print function is available via PRI key on the operation panel, which will print out data contained in each stored file as required.
- 4.17 In Knoop's hardness test, the testing procedure stipulates that only d will be measured. Except for that, the working procedure and status are similar to that of Vicker's hardness test. For screen display, refer to Figure 11.

- 4.18 In storing current testing data, press ESC first to return to main menu. Then press → to activate FILE menu on the screen. Among the five sub-commands, highlight SAVE and confirm by ENTER. The “Input File No:” prompt will appear on the screen, waiting for your input of file number. Input file number through num keys and the number must contain 6 digits. The 6 digits can be randomly selected. Input will not be accepted if it is less or more than 6 digits. Confirm your input by ENTER and the current test data will be saved.

Note: ⌘ Save command will be effective only after testing is done. Under non-working status (i.e. no testing or measuring or after reset), the Save command is inactive. ⌘DATEIN is for recording when the file is saved. To use this function, you need to highlight DATEIN and confirm by ENTER. The “Input Date (mm/dd/yy): \_” prompt will then appear on the screen, requesting the input of the date. The format for date input must be standardized. For example, 04201998 will be the correct input if the current data is 20 April 1998. Confirm by ENTER after date input. Then highlight Save command and confirm to store the file with date information. The stored date can be retrieved via file printing or the following commands in the FILE menu.

- 4.19 Load allows to display the content of the required file. Move direction keys to highlight Load and confirm by ENTER. The “Input File No:” prompt will appear on the screen. Input the required file number through num keys and confirm by ENTER when input completes. Then the content, data and calculation results contained in the selected file number will be displayed. Use ↑, ↓ keys to scroll through displays if there are a lot of data shown on the screen. Similarly, calculation results displayed can also be browsed by pressing direction keys. (Figure 14, 15, 16)
- 4.20 Dispall allows to display all files in store. 28 files can be stored in maximum by HVS-10. Move direction keys to highlight Dispall and confirm by ENTER key. Use again →, ← keys to browse data contained in all files one by one.
- 4.21 DispNO is used to display file numbers. Highlight DispNO and confirm by ENTER. 28 file numbers (0~27) can be displayed in maximum. However, one screen page only allows 13 file numbers at one time and you may go to the next page via ↑, ↓ keys.
- 4.22 As the machine can only store 28 files in maximum, you have two alternatives when you want to save new files after the storage is full. If you continue saving a new file, the first file in store will automatically be deleted. For example, if there are 28 files already in store with numbers from 00~27, then file numbered 00 will be removed after you save the new file. So the new file list in store becomes 01~28 and the last file will take on the file number 28. The other alternative is to replace existing files in store. Use Save function and the stored data will be totally replaced by the current data, file order and file number remaining unchanged. (Figure 12, 13)

## 5. Tips & Special Attentions

- 5.1 Read the User’s Manual carefully before use. Pay attention to operation procedures and notes so as to avoid instrument damages or human injuries.
- 5.2 Please DO NOT use unqualified persons to disassemble electric components, switches and power sockets in order to avoid accidents.
- 5.3 DO NOT turn the Revolving Wheel when testing pressure is being loaded or has not yet been unloaded. Otherwise, the machine and the diamond indenter will be damaged. You can turn the Revolving Wheel only after you hear a beep which indicates that the pressure has been unloaded.
- 5.4 While the machine is in the status of measuring, DO NOT load pressure. If you touch START

by accident, DO NOT turn the Revolving Wheel until the loading is completed.

5.5 If the machine is not in use for a long time, gently push the indenter upwards several times with your hand before starting the tester.

#### 5.6 About the diamond indenter

- ⌘ The Diamond Indenter (1) and the Indenter Spindle are two critical parts of the tester. Special caution is required in operation to avoid hitting the indenter.
- ⌘ To maintain testing accuracy, keep the indenter clean. Use absorbent cotton and alcohol (or ether) to gently clean the indenter tip if it is contaminated by dust or oil.

#### 5.7 About the Micro Eyepiece

- ⌘ Since people's eyesight varies, the marks in the Eyepiece vision may be unclear to a new observer. So, the new observer should adjust the lens of the Eyepiece slightly first to get a sharp view of the inner side of the mark.
- ⌘ The Eyepiece is within the Eyepiece Tube and make sure that the micro eyepiece closely contacts the eyepiece tube when you are turning the eyepiece 90° to measure the diagonals of the indentation. The measuring accuracy may be affected if the eyepiece is not tightly contacting the tube.

#### 5.8 About light source for microscope

- ⌘ The central position of the light source will directly affect the image quality of the indentation. If the image is fuzzy or unevenly lighted, you need to center the light source. Carefully adjust the three screws to align the bulb center with that of the light source. (Figure 21).

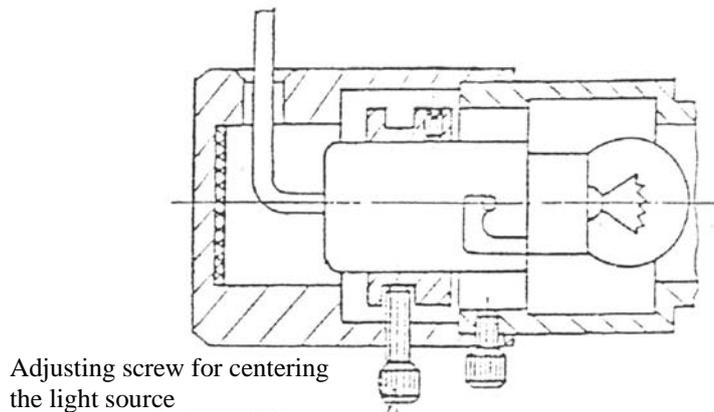


Figure 21

#### 5.9 About the sample

Keep the sample surface clean. Any oil or dust on the surface will affect the measuring accuracy. Use alcohol or ether to gently rub it clean.

#### 6.0 About the microscope camera

- ⌘ The machine is equipped with a microscope camera which is used to take photographs of the testing results on the material being tested. Remove the photographing cover on the top cover before installing the camera. Take the camera out of the accessory box and connect it onto the screw seat of the eyepiece.
- ⌘ Remove the standard lens of the camera and connect the camera with the lens hole. Make sure the spring snaps locked.
- ⌘ Observe the surface through the micro eyepiece. When you see a sharp image, pull out the Switching Lever for Photographing and Measuring (15) on the left side of the main body and the light route is changed into photographing status.
- ⌘ Observe again through the eyepiece of the camera. Slightly adjust the visibility tuning ring or the Lifting Screw (7) to get a sharp image.

⊗ Activate the shutter to take the photograph of the surface.

#### IV. Accessories (Packing List)

1. Main machine (including 1 micro Vicker's indenter, 1 10<sup>X</sup> Measuring)
2. Testing table, weights and microscope accessory box
  - Weights 4 pieces
  - Big, medium and small "V" –shaped testing table 1 for each type
  - Leveling screws 4 pieces
  - Power cord 1
  - 10<sup>X</sup> digital type micro eyepiece 1
  - Standard block in Vicker's hardness 2 {1 for medium-hard (5Kg), 1 for medium-hard(30Kg)}
  - Spare bulb 2
3. Quality Certificate 1
4. User's Manual 1
5. Operation Manual for Printer 1
6. Spare FUSE(1A,2A) 2 for each type

#### Optional items:

- Main body of the photographing apparatus 1
- Photographing eyepiece (6.4<sup>X</sup>, 4<sup>X</sup>) 1 for each type
- Shutter line 1
- Dark box 1
- Special film sheet cassette 3
- DF-300X camera 1