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OPERATION MANUAL

ISH-TDV1000

Auto-Turret Digital Micro Hardness Tester



Caution: Before the first operation of the tester, the operator should carefully read the Operating Manual and remove the transport provisions according to the procedures described in Section 0 Precaution, Pages 3 - 4.

Packing List

Product: Auto-Turret Digital Micro Hardness Tester
Model: ISH-TDV1000

1. Tester proper, with Vickers indenter & objectives 40x and 10x calibrated	1 set
2. Digital micrometer eyepiece	1 pc.
3. Standard micro hardness block	1 pc.
4. Parallel-jaw vice	1 set
5. Sheet specimen clamp	1 set
6. Cylindrical -specimen clamp	1 set
7. Auxiliary stage	1 set
8. Circular bubble leveler	1 pc.
9. Spare lamp	1 pc.
10. Spare fuse	2 pcs.
11. Power cable	1 pc.
12. Screwdriver for removal of transport provision	1 pc.
13. Hexagon wrench, M3	1 pc.
14. Hexagon wrench, M4	1 pc.
15. Certificate of Quality	1 pc.
16. Operating Manual	1 copy

ISH-TDV1000 Auto-Turret Digital Micro Hardness Tester

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ISH-TDV1000 Auto-Turret Digital Micro Hardness Tester

Precaution

1. The operator should fully understand the contents of the Operating Manual before operating the tester.
2. Before the first operation of the tester, the transport provisions should be removed in the following procedures:
 - 2.1 Don't connect the power cable at first.
 - 2.2 Refer to Fig. 3. Unscrew the dust plug (13) at the tester's top and take down the top cover (28).

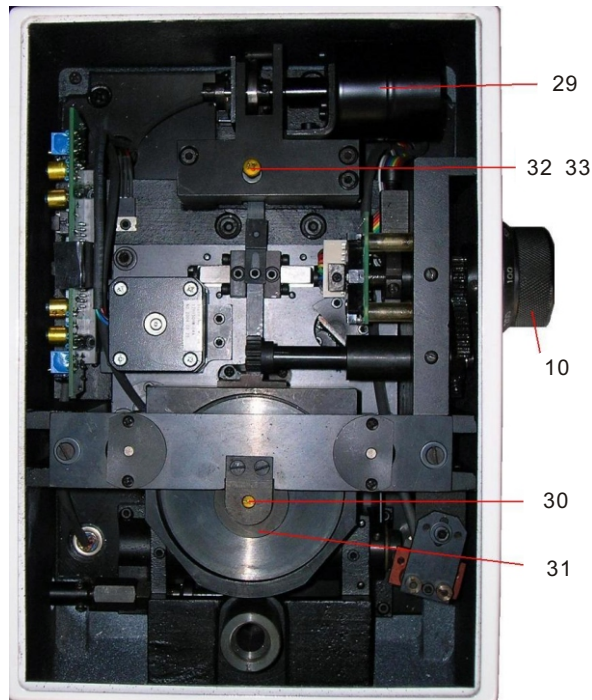
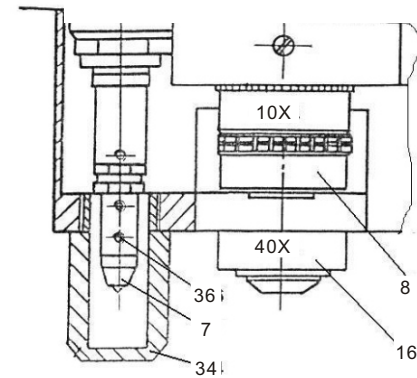


Fig.1 Removal of Transport

10. Load-change handwheel 29. Loading motor 30. Fixing screw for transport
 31. Transport-provision disc 32. Fixing screw for transport 33. Fixing nut for transport

- 2.3 See Fig. 1. Loosen the fixing screw (30) and take down the provision disk (31).
 Please keep the provision disk (31) properly for future use.
 Loosen the fixing screw and nut (32 and 33).
 The removal of the transport provisions is completed.
- 2.4 Close the top cover (28). Remount the dust plug (13).
- 2.5 Remove the indenter protective sleeve (34), see Fig. 2.



7. Diamond indenter
 8. Objective, 10X
 16. Objective, 40X
 34. Indenter sleeve
 36. Indenter set screw

Fig.2 Removal of indenter sleeve

- 2.6 Refer to Figs 2A, 3 and 4. Mount the eyepiece micrometer on the tester. Connect the eyepiece signal wire. Take notice of the groove's direction. The groove of signal plug (18) should be directed at the red point on the tester.

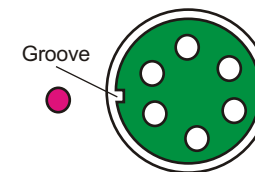


Fig.2A Eyepiece encoder connector

- 2.7 Connect the power cable.
 Turn on the power switch at the back panel. Press button RESET.

3. If the test piece is less than 40 mm in height, the auxiliary stage should be used.
4. During the whole process of loading, load duration and unloading, don't turn the turret. The turret can be turned only when a complete process of load application is completed (i.e. both the green and red loading indicators are in off).
5. The turret is turned to its perfect position only when a click is heard.

1. Scope of Application

ISH-TDV1000 Auto-Turret Digital Micro Hardness Tester, composed of precision mechanism, optical and electrical systems, is mainly used

- (1) To determine micro hardness of finished surface of small-size or sheet-like parts, micro hardness of superficial layers such as electroplated, carburized, nitrided and cyanided layers, and micro hardness of brittle materials such as glass, agate, ceramics and other non-metallic materials;
- (2) As a metallurgical microscope, i.e. to examine and take photograph of microstructure of materials and also to determine micro hardness of the phase structure for analytical purpose.

2. Main Specifications

- (1) Automatic turret for Indenter / Objective change.
- (2) Test force: 10, 25, 50, 100, 200, 300, 500, 1000 gf.
- (3) Duration time: 5, 10, 15, 20, ..., 60 sec. in step of 5 sec.
- (4) Magnification:
 - Objective: 40x, 10x (for observation);
 - Eyepiece: 15x;
 - Total: 600x, 150x (for observation).
- (5) Division unit:
 - Eyepiece micrometer: 0.001 mm
 - Differential drum of worktable: 0.01 mm.
- (6) Real division value of micrometer: 0.025 μm
- (7) Parameters of diamond indenter:
 - (a) Vickers indenter:
 - Angle between opposite faces: $136^\circ \pm 15'$
 - Off-set: not greater than 1 μm.

- (b) Knoop indenter (option):
 - Angle between opposite edges: $172^\circ 30' \pm 5'$ and $130^\circ \pm 30'$.
 - Off-set: not greater than 1 μm.
- (8) Adjustable range of worktable: X: 15 mm, Y: 15 mm.
- (9) Max. Height of test piece: 80 mm.
- (10) Dimensions: 340 x 220 x 500 mm
- (11) Net weight: 27 kg

3. Principle of Hardness determination

The micro hardness test involves a microscopic and static method, of which the results are mostly expressed in terms of Vickers and Knoop hardness numbers.

The micro hardness tester is provided with an optical magnifying system. The hardness is determined by penetrating a diamond pyramid indenter under a known test force into the surface of test piece and then measuring the diagonal of the indentation left on the surface after removal of the test force.

The hardness number is calculated upon below equations.

3.1 Vickers test

$$HV = 1854.4F / d^2.$$

Where, HV-Vickers hardness number, in kg/ mm², F Test force, in gf, and d-Diagonal length of the indentation, in μm.

3.2 Knoop test

$$HK = 14229F / d^2.$$

Where, HK-Knoop hardness number, in kg / mm², F Test force, in gf, and d- Length of the longer diagonal of the indentation, in μm.

4. Structure

The tester is mainly composed of worktable & lifting system, turret, auto-loading mechanism, measuring microscope, and control & display system.

4.1 External appearance

Refer to Fig. 3.

4.2 Lifting system & worktable

One turn of hand wheel (3) makes the lifting shaft (22) displaced vertically by only 0.5 mm.

On the top of the lifting shaft is mounted worktable (6). By turning X or Y differential drum, the worktable surface is moved in relative direction, so as to quickly find out in field of vision the spot where hardness test is to be made.

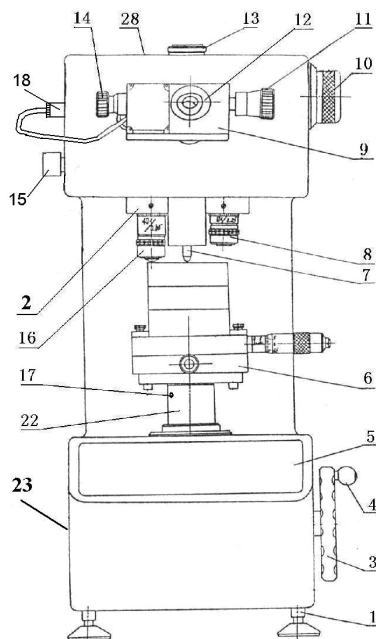
The holes on the worktable are used to fix attachments.

When the worktable set screw (17) is loosened, the worktable can be turned through any angle for special use.

Note: It is advisable not to lift the worktable too high. When the test piece is less than 40 mm in height, use an auxiliary stage.

4.3 Turret

On the turret is mounted an indenter and two objectives (40x and 10x). The turret is driven with a program-controlled motor. In the turret a ball-spring mechanism is provided to secure precision positioning of indenter and objective. The indenter or objective is in its correct position only when a click is heard.



1. Foot screws
2. Turret
3. Lifting hand wheel
5. Control & display
6. Worktable
7. Diamond indenter
8. Objective, 10x
9. Eyepiece micrometer
10. Load-change hand wheel
11. Right adjusting drum
12. Sight-degree ring
13. Dust plug (Photo-tube hole)
14. Left adjusting drum
15. Meas./Photo handle
16. Objective, 40x
17. Worktable set screw
18. Eyepiece signal connector
22. Lifting shaft
28. Top cover

Fig. 3 External appearance of HXD-1000TM Tester

There are provided two ways for moving the turret.

(1) Way 1: by pressing button **START** once.

If required, press button **RESET** to set the objective 40x in the origin (front) position.

Press button **START**. The turret turns through 90° and the indenter stops in the front position, with a click heard. Then a complete process of loading, load duration and unloading is automatically completed.

After that, the turret turns back, until the objective 40x returns to its origin front position. The indentation can then be measured.

(2) Way 2: by pressing Step button (See Fig. 6 (10) Step button) Press button **RESET** to set the objective 40x in the origin (front) position.

Press the Step button once. The turret turns through 90° and the indenter stops in the front position, with a click heard. If an indentation is required to be made, press button **START**.

Press the Step button again, the turret turns through another 90° and the objective 10x stops in the front position. That is specially designed for observation with the objective 10x. Press the Step button again, the turret turns back through 180° and the objective 40x returns to its origin front position, with a click heard.

Note: It is advisable not to turn the turret directly with hand to ensure the turret working properly and positioning correctly.

In case the turret has been turned directly with hand, press the button RES.

4.4 Auto-loading mechanism

Refer to Figs. 1 and 2. It is composed of program-controlled motor drive, lever and weights. The load-change hand wheel (10) is used for selecting test force. When the load-change hand wheel (10) is turned, the number displayed on the test force window is changed.

Note: The load-change handwheel is set in the perfect position only when a click is heard. Sometimes the test force indicated on the window would not be right if a click had not been heard.

By press button **START**, a complete process of loading, load duration and unloading will be automatically completed.

4.5 Measuring microscope

The measuring microscope is equipped with two objectives, of which, one having strictly calibrated magnification of 40x is for both observation and measurement, and the other having magnification of about 10x is for observation only. Refer to Figs. 4 and 8.

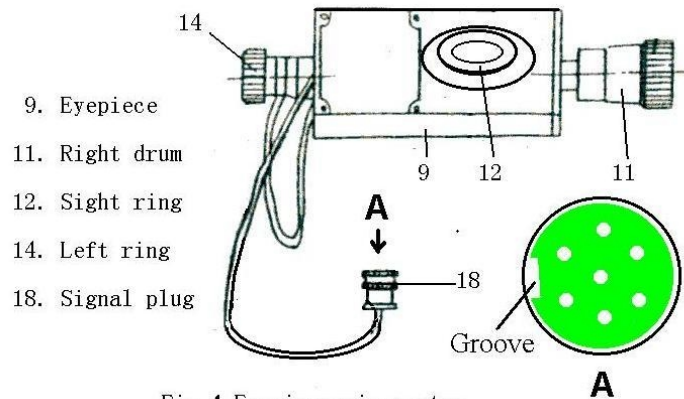


Fig.4 Eyepiece micrometer

Within the micrometer eyepiece, two sets of guides and reticules are provided, hence, the diagonal length of the indentation is determined through one-time reading.

When the left drum (14) is turned, both reticules will move together in the field of vision, and the left line of the parallel lines can be aligned with the left vertex point of the indentation.

When the right reading drum (11) is turned, only one reticule will move in the field of vision, and the right line of the parallel lines can be aligned with the right vertex point of the indentation. Then a reading of the diagonal is obtained.

The microscope can also be used to take microphotograph. To this purpose, take down the dust plug (13) and mount the photo connecting tube on the place, and turn the Meas./ Photo change handle to the photo position. For details on photo taking procedure, see "Instruction Manual of Metallurgical Micro Photographic Set".

4.6 Control & display

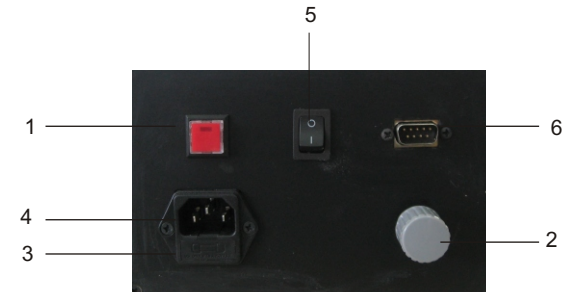
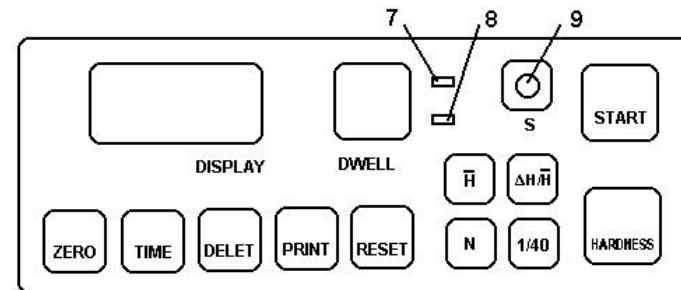


Fig.5 Controls on back
 1. Power switch 2. Light intensity adjuster
 3. Fuse 4. Power socket
 5. HV/HK switch 6. Output for printer

Figs. 5 and 6 show controls and displays of the tester, of which the main functions are described briefly as below.



7. Red LED 8. Green LED 9. Step button

Fig. 6 Control and display

Power switch (1) is placed on the back panel of the tester. When it is turned on, the numbers on windows light up.

Adjusting knob (2) is used to adjust light intensity of illuminator. Switch HV / HK (5) is used to select hardness scale, position 0 is for HV scale and position 1 for HK scale.

Output socket (6) is to be connected with printer for recording.

On the front panel, the DISPLAY window is for displaying the test force selected. There are provided eight steps of test force, i.e. 10, 25, 50, 100, 200, 300, 500 and 1000 gf. The test force has been correctly selected with the load-change handwheel only when a click is heard.

The DISPLAY window is also used to display:

- Diagonal length of indentation magnified by 40x during measuring, or
- Real length of the diagonal after pressing button 1/40, or
- Hardness value measured after the second pressing of button HARDNESS, or
- Average hardness value after pressing button H, or
- Divergence after pressing button Δ H/H**

The DWELL window is for displaying duration (dwell) time. When the tester is started or after it is reset, the duration time is automatically set in 15 seconds, that is mostly used in practice.

Button RESET is used to reset the tester. If the tester is not in normal status or some mistake takes place during testing, press the button RESET.

Note: After pressing the button RESET, the eyepiece's zero-setting should be re-made. Refer to Section 5.4.1, Eyepiece zero setting.

Button TIME is used to set duration time. When a duration time other than 15 sec. is required, press the button repeatedly until the required time is obtained. The duration time displayed will be changed in step of 5 seconds as below:

15, 20, 25, 30, ... , 60, 5, 10, 15.

Button 1/40 is used to display the real diagonal length of the indentation.

Button START for starting load application. Also refer to Section 4.3, Turret.

- (1) In case that the objective 40x is in the front position, the turret will turn automatically until the indenter is in the front position. After a complete process of loading, load duration and unloading is completed, the turret will turn again until the objective 40x returns to the front position.
- (2) In case that the indenter is in the front position, only a complete process of loading, load duration and unloading will be completed.

A complete process of load application is as below:

Description	Green LED	Red LED
Before pressing button START	off	off
After pressing button START	on	off
In load applying with indenter descending	on	off
In load duration with number subtracting	off	on
During load removal with indenter rising	on	off
End	off	off

Button S is used to turn the turret step by step, also see Section 4.3, Turret.

Button ZERO is used to zero the eyepiece encoder. Refer to Section 5.4.1 Zero setting of eyepiece encoder.

Button HARDNESS is used to display hardness value measured. The hardness value is displayed after measuring one diagonal and pressing button HARDNESS twice, or, after measuring one diagonal and pressing button HARDNESS once and then measuring another diagonal and pressing button HARDNESS once more.

Button N is used to confirm the N-th measurement for further statistic analysis. It is also used to delete, in coordination with the button DELETE, the N-th measurement value, which is found clearly wrong in the statistics. Refer to Section 5.4.3.

Button H is used to display the average hardness value. Refer to Section 5.4.3.

Button Δ H/H is used to display divergence. Refer to Section 5.4.3.

Button DELETE, in coordination with button N, is used to delete the N-th measurement value. Refer to Section 5.4.3.

Button PRINT is used to print out all data measured. Refer to Section 5.4.3.

5. Operation

5.1 Installation

5.1.1 Removal of transport provisions

Refer to Precaution and Figs. 1, 2, and 3. Loosen the protective screws (30, 32) and nut (33), remove the protective disk (31). Remove the indenter sleeve (34).

5.1.2 Leveling of the tester

Place the circular bubble leveler on the worktable and adjust foot screws until the bubble of the leveler is at the center. The worktable is then in the horizontal position and the axis of the loading shaft is in accord with the plumb line.

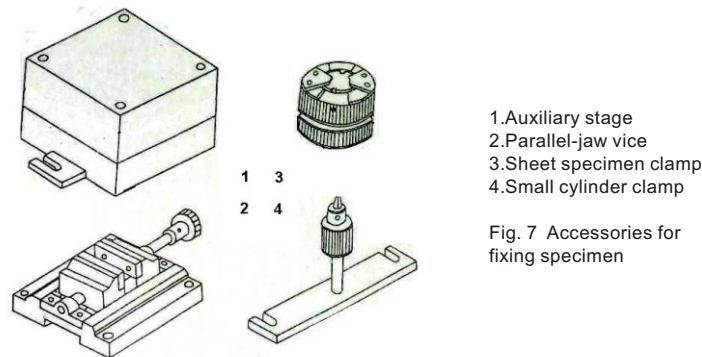
5.1.3 Setting eyepiece encoder

When connecting the eyepiece signal wire, be sure that the groove of the plug is in the correct direction. See Precaution, Fig. 2A.

5.2 Fixation of test piece

There are provided accessories for fixing specimens: auxiliary stage, parallel-jaw vice, sheet specimen clamp and small cylindrical specimen clamp. See Fig. 7.

When the parallel-jaw vice or the sheet specimen clamp is used, an auxiliary stage should be attached on the tester's worktable. Rectangular or cylindrical specimen can be fixed on the parallel-jaw vice. When fixing, it is advisable to turn over the vice to make the jaws contact with a smooth plane (e.g. a glass plate). Then insert the specimen into the jaws and clamp it. The surface of the test piece is thus perpendicular to the indenter.



Sheet-like test piece can be fixed with the sheet specimen clamp. To test hardness of end surface of thin cylindrical testpiece with a diameter less than 4 mm, the cylinder specimen clamp can be used. It is mounted on the worktable with two long knurled screws.

5.3 Operation of the tester

5.3.1 Setting test piece

Select a proper fixture in accordance with Section 5.2 and mount it on the worktable. Turn on the power switch. Press button RESET.

5.3.2 Setting test force

Select a required test force by turning the load-change handwheel (10), with a click heard. The selected test force is shown on the DISPLAY.

5.3.3 Focusing

Set the objective 40x in the front (origin) position, with a click heard. Adjust the sight degree ring (12) of the eyepiece until the reticule line is clear in the field of vision. Adjust the lifting hand wheel (3) until the testpiece's surface is seen distinctly in the field of vision.

The objective 40x is of high power and the focal depth is very short. It is therefore not easy for an inexperienced operator to fine out the image. The operator should do some tests with a test piece of high flatness but of not very high finish as below:

Adjust the lifting hand wheel so that the testpiece is near to contact with the objective. Then turn the lifting hand wheel backwards about one revolution. Again, slowly adjust the lifting hand wheel upward until the image of the test piece surface is clearly seen in the field of vision.

If the lines in the eyepiece are not distinct enough, the sight-degree ring (12) should be adjusted (see Figs.3 and 4). The focussing at specimen should be made after the best resolution of the lines has been obtained in the field of vision.

Adjust both X and Y drums of the worktable to locate in the field of vision the spot where the hardness test is to be made.

5.3.4 Load application

Press button START. The turret automatically turns through 90° and the indenter stops in the front position. After a complete auto process of loading, load duration and unloading, the turret turns back through 90° and the objective 40x returns to the origin front position.

To accurately locate a required spot, a trial indentation can first be made. Ideally, the indentation should be in the center of the field of vision. However, it often happens that the indentation deviates from the center more or less. A little deviation, of course, is permissible. Turn the left drum of the eyepiece micrometer (see Figs. 4 and 8) to make the center of the lines coincide with the center of the reference indentation. The subsequent indentations will then fall in this center area.

Note: In locating the trial indentation, don't turn the either X or Y drum of the worktable.

If the deviation of indentation from the center of the field of vision is large, further adjustment is required in accordance to Section 6.3 Coincidence Calibration.

5.4 Determination of Vickers hardness

Select HV hardness scale by using button HV / HK.

Refer to Fig. 5. The position 0 is for HV hardness scale, while position 1 is for HK hardness scale.

5.4.1 Eyepiece zero setting

Refer to Fig. 8. Turn the right drum of the eyepiece micrometer so that the inner sides of the two dark parallel lines are just in touch with each other in the field of vision.

Press button ZERO.

5.4.2 Alignment and reading

Adjust X and Y differential drums of worktable and also the left and right drums of the eyepiece micrometer, so that the inner sides of the parallel dark lines coincide precisely with the two opposite vertexes points of the indentation respectively, as shown in Fig. 8. If the parallel lines are not perpendicular to the diagonal of the indentation, turn the eyepiece micrometer until they are.

Whatever the indentation's edges are ideally straight or somewhat curved, the alignment should be made with reference to the vertex points of the indentation.

The number shown now in the DISPLAY window is the length of the first diagonal of the indentation, that has been magnified by the objective 40x.

Press button HARDNESS once.

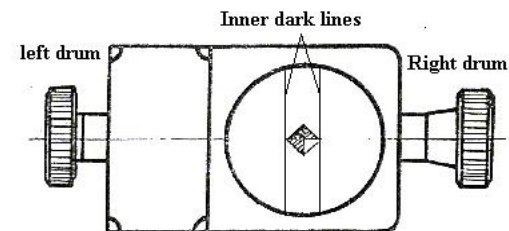


Fig. 8 Alignment of indentation

If the indentation is an ideal square (i.e. the two diagonals are equal in length), press button HARDNESS once more. The hardness value is displayed on the window.

If the indentation is not an ideal square (i.e. the two diagonals are in different lengths), turn the eyepiece micrometer through 90°, align and take reading of another diagonal of the indentation. Then press the button HARDNESS once more. The hardness value is displayed on the window.

The hardness measurement of the first point is completed.

5.4.3 Other functions

(1) Multi-point measurement

After the completion of hardness measurement of the first point, press button N. The first measurement is confirmed and memorized.

Similarly, after the completion of the second point measurement, press button N to confirm and enter the second measurement. For further points, repeat above steps, and press button N after each completion of the N-th point measurement. The max N can be up to 9.

(2) Average value

Press button H, the average (mean) value will be displayed on the window.

$$H = (H_1 + H_2 + \dots + H_N) / N .$$

(3) Divergence

Press button $\Delta H/H$, the divergence of measurements is displayed on the window. $\Delta H/H = (H_{max} - H_{min}) / H$.

(4) Print out

If the tester has been connected, by pressing button PRINT the measured data and statistics are printed out, as below.

```
SSOIP HMIS-C
MEASURING LOG (HV)
MEAS. FORCE (GF)
1000.0 (9.8103N)
LOAD DURATION (S) 15
DATE: PART-NO.
TESTER-NO.
01 51.373 The length of first diagonal of the first indentation
51.348 The length of second diagonal of the first indentation
703.95 Hardness number of the first point
50.996
50.996
02 712.96 Hardness number of the second point
51.373
51.373
03 702.59 Hardness number of the third point

STATISTIC
N 03 Total points tested
AVG 706.16 Mean hardness value (average)
DD 0.0146 Divergence, i.e. ΔH/H
S 5.8799 Standard deviation
```

If more piece of Test report is required, press button PRINT once more.

(5) Delete

In case that some measured point(s) is found to be mistaken obviously and should be deleted from the statistics. Press button DELETE. A sign CE appears on the DISPLAY window. Press button N once or several times until the number displayed is just the serial number of the point where mistaken test has taken place. Press button DELETE once more. The mistaken datum is cleared off.

5.5 Brief of operating steps

- (1) Press button RESET.
- (2) Select a required test force by turning load-change hand wheel, with a click heard.
- (3) If required, select a duration time by pressing button TIME.
- (4) Make focussing on the specimen's surface distinctly.
- (5) Press button START. The turret automatically turns through 90° and the indenter stops in the front position. After a program-controlled process of loading, load duration and unloading is completed, the turret turns back through 90° and the objective 40x returns to the origin front position.
- (6) Make zeroing of the eyepiece micrometer. See Section 5.4.1. Note: This step is required only for the first diagonal's measurement.
- (7) Measure one diagonal length of the indentation D1. Press button HARDNESS once. (If required, measure the second diagonal of the indentation D2.) Press button HARDNESS once more. The hardness value is displayed.
- (8) When more points are to be tested: Press button N. Move the X or Y differential drum of X-Y worktable to select another point to be tested. Repeat above Steps (5) and (7). Press button N.
- (9) If required, press button H.
- (10) If required, press button ΔH/H.
- (11) If required, press button PRINT.

5.6 Determination of Knoop hardness

5.6.1 Replacement of indenter

Refer to Figs. 2 and 3, loosen the indenter-set screw (36). Take down the Vickers indenter and mount the Knoop indenter on it. The longer diagonal of the Knoop indenter should be arranged in X-direction. Re-tighten the set screw (36).

5.6.2 Determination of Knoop hardness

First, select the Knoop hardness scale by using the HV/HK switch, see Fig. 5. The procedure for determining Knoop hardness number is mainly the same as that for Vickers, except that the measurement is made for only one diagonal (the longer diagonal). Press button HARDNESS twice.

6. Maintenance, Calibration and Packing

6.1 Maintenance

The tester should be placed in a room free from dust, moisture, vibration and corrosive gases. The ambient temperature should be within $20 \pm 10^\circ\text{C}$, and the relative humidity not greater than 70%.

The lifting shaft (22) should be regularly oiled with spindle oil (refer to Fig. 3). When the tester is not in use, the worktable should be kept in low position so as to protect the shaft from being affected by dust, dirt and others.

Dust on surface of optical elements can be removed with a small air blower. Dirt or stains should be removed by using absorbent cotton or lens tissue slightly with alcohol-ether mixture. Care must be taken to prevent the bonded layer of the optical elements from being digummed by the mixture penetrating through lens edge.

6.2 Replacement and calibration of illuminator

The illuminator is so designed that it works in a voltage much lower than the nominal value. It is therefore the lamp will have a long life-span.

In case the lamp is broken, replace and calibrate it as below. Refer to Fig. 9.

Loosen fixing screw (40). Loosen the two setting screws (41). Then take out the illuminator unit.

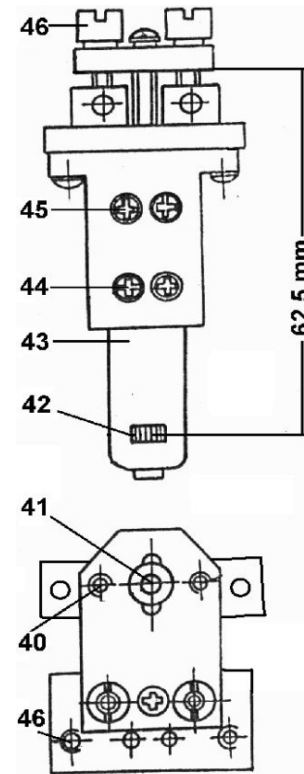
Loosen two lamp-set screws (44) and take down the broken lamp.

Mount a new lamp on it and tighten the two lamp-set screws (44).

Re-mount the illuminator unit on and slightly tighten the fixing screw (40). Adjust the illuminator in all directions (back/forth, up/down and right/left) until the whole field of vision is bright and uniform and the image is distinct.

Tighten the fixing screw (40) firmly. Take notice of dimension 62.5 mm.

Tighten the two setting screws (41).



- 40. Fixing screw M4
- 41. Setting screws M3
- 42. Filament
- 43. Lamp
- 44. Lamp-set screws
- 45. Wire set screws
- 46. Adjusting screws

Fig. 9 Replacement and Calibration of Lamp

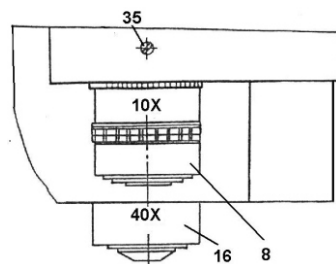
6.3 Coincidence calibration

If the deviation of the indentation from the center of the field of vision is not great, the calibration is usually not required. If it is great, the calibration can be made by calibrating three adjusting screws (35) on the turret. See Fig. 10.

It is pointed out that the calibration of coincidence must be made very carefully and the adjusting screws (35) be calibrated very little.

During the calibration, the worktable should not be adjusted.

By the end of calibration, tighten the adjusting screws.



8. Objective, 10x
16. Objective, 40x
35. Coincidence adjusting screws

Fig. 10 Coincidence Calibration

6.4 If the hardness measured lower than the standard

If the hardness values measured in some test force (e.g. 300 gf) and smaller forces are always lower than the standard, the weights-holding set (37) is probably descended and excessive load is applied on the test piece. Follow below steps to adjust it, see Fig.11.

- (1) Take out the hexagon wrench (for the fixing screw of M3) from accessory box.
- (2) Turn the load-change hand wheel (10) to select 10 gf force (The mark "10" on the hand wheel is directed to the red point). The weights container is now in its top position. The hexagon-hole fixing screw (38) should be upward and can be seen.
- (3) Turn the screw (30) clockwise (downwards) until it touches the top weight. This is to establish a reference for the height of the weights container.
- (4) Turn off the power switch.
- (5) Loosen the fixing screw (38) with the hexagon wrench.
- (6) Turn the screw (30) counter-clockwise (upwards) about 1-1.5 rotations.
- (7) Raise the weight container until the top weight (39) touches with the screw (30).
- (8) With a hand holding the whole weights container in its top position, re-tighten the fixing screw (38) firmly.

Try the hardness measurement, if the result is not satisfactory, repeat above adjustment. Usually, if the measured value is lower than the standard, the whole weights container (37) should be adjusted upwards and, if the measured value is higher than the standard, the weights container (37) should be adjusted downwards. But the adjustment is very little (about 1-1.5 mm).

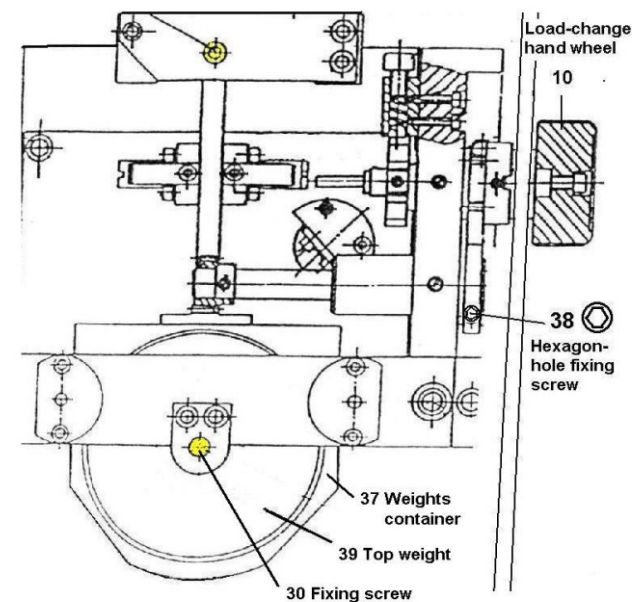


Fig.11

6.5 Notes on packing

When the tester has to be moved, the transport provisions should be mounted on the tester in order to prevent the loading mechanism from being damaged due to colliding with other parts. The procedures are as below.

Refer to Figs. 1, 2 and 3.

Lower the worktable. Turn the load-change hand wheel (10) to select the largest load 1000 gf, with a number '1000' being indicated on the DISPLAY window. Turn off the power switch and take down the power cable.

Mount the indenter protective sleeve (34) onto the turret. (See Fig. 2).

Remove the dust plug (13). Take down the top cover (28).

See Fig. 1. Set the fixing screw M4 (32) and the fixing nut M4 (33) on the hole. When the screw slightly touches the lever below, fix the screw and nut (32, 33).

Place the circular provision disk (31) on weights and fix it with the fixing screw M5 (30).

Re-mount the top cover (28). Re-mount the dust plug (13).