PACE® TECHNOLOGIES
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ALPHA MHT-1000Z Microhardness Tester

INSTRUCTION MANUAL

3601 E. 34th St. Tucson, AZ 85713 USA Tel. +1-520-882-6598 Fax +1-520-882-6599 email: pace@metallographic.com Web: https//www.metallographic.com

Equipment Type:	Microhardness Tester (Vickers and Knoop)
Model:	***ALPHA MHT-1000Z***
Electrical Requirements:	110/220 Volts (single-phase)
Frequency:	50/60 Hz
Manual Revision Date:	April 24, 2024

Please read this instruction manual carefully and follow all installation, operating and safety guidelines.

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WARRANTY

Terms and Conditions applying to all PACE Technologies Products

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PACE Technologies Products are warranted for two years from the purchase date to be free from defects in material and workmanship under correct use, normal operating conditions, and proper application. PACE Technologies obligation under this warranty shall be limited to the repair or exchange, at PACE Technologies option, of any PACE Technologies Product or part which proves to be defective as provided herein. PACE Technologies reserves the right to either inspect the product at Buyer's location or require it to be returned to the factory for inspection. Buyer is responsible for freight to and from factory on all warranty claims. The above warranty does not extend to goods damaged or subjected to accident, abuse or misuse after release from PACE Technologies warehouse, nor goods altered or repaired by anyone other than specifically authorized PACE Technologies representatives. PACE Technologies shall not in any way be responsible for the consequences of any alteration, modification or misuse unless previously approved in writing by an officer of PACE Technologies. Note: Corrosion is considered a maintenance issue and not a warranty issue.
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3. DELIVERY:
Customer assumes and shall bear the risk of all loss or damage to the Products from every cause whatsoever, whether or not insured, and title to such Products shall pass to Customer upon PACE Technologies delivery of the Products to the common carrier of Pace Technologies choice, or the carrier specified in writing by Customer, for shipment to Customer. Any claims for breakage, loss, delay, or damage shall be made to the carrier by the Customer and Pace Technologies will render customer reasonable assistance in prosecuting such claims.

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4. ACCEPTANCE:
Customer shall inspect the Products promptly upon receipt of delivery. Unless customer objects in writing within thirty (30) business days thereafter, customer shall be deemed to have accepted the Products. All claims for damages, errors, or shortage in Products delivered shall be made by Customer in writing within such five (5) business day period. Failure to make any claim timely shall constitute acceptance of the Products.

5. PAYMENT:
Customer agrees to provide timely payment for the Products in accordance with the terms of payment set forth on the reverse side hereof or in any proposal submitted herewith. If any payment is not paid on or before its due date, Customer shall pay interest on such late payment from the due date until paid at the lesser of 12% per annum or the maximum rate allowed by law.

6. DEFAULT:
If Buyer is in default (including, but not limited to, the failure by Buyer to pay all amounts due and payable to Seller) under the work or purchase order or any other agreement between Buyer and Seller, Buyer 's rights under the warranty shall be suspended during any period of such default and the original warranty period will not be extended beyond its original expiration date despite such suspension of warranty rights.

7. MISCELLANEOUS PROVISIONS:
This agreement has been made in and shall be governed by the laws of the State of Arizona. These terms and conditions and the description of the Products on the reverse side hereof or in any proposal submitted herewith constitute the entire agreement and understanding of the parties with respect to this sale and supersede all prior and contemporaneous agreements or understandings, inducements or representations, expressed or implied, written or oral, between the parties with respect hereto. Any term or provision of this Agreement may be amended, and any observance of any term of this Agreement may be waived, only by a writing signed by the party to be bounds. The waiver by a party of any breach shall not be deemed to constitute a waiver of any other breach. Should suit be brought on this Agreement, the prevailing party shall be entitled to recover its reasonable attorneys' fees and other costs of suit including costs and attorneys' fees incurred on appeal or in collection of any judgment., errors, or shortage in Products delivered shall be made by Customer in writing within such five (5) business day period. Failure to make any claim timely shall constitute acceptance of the Products.

8. RESTOCKING FEE:
All Returns are subject to a restocking charge equal to 15% (fifteen percent) of the Invoice, unless the Goods are proved to be non-conformed by PACE Technologies.

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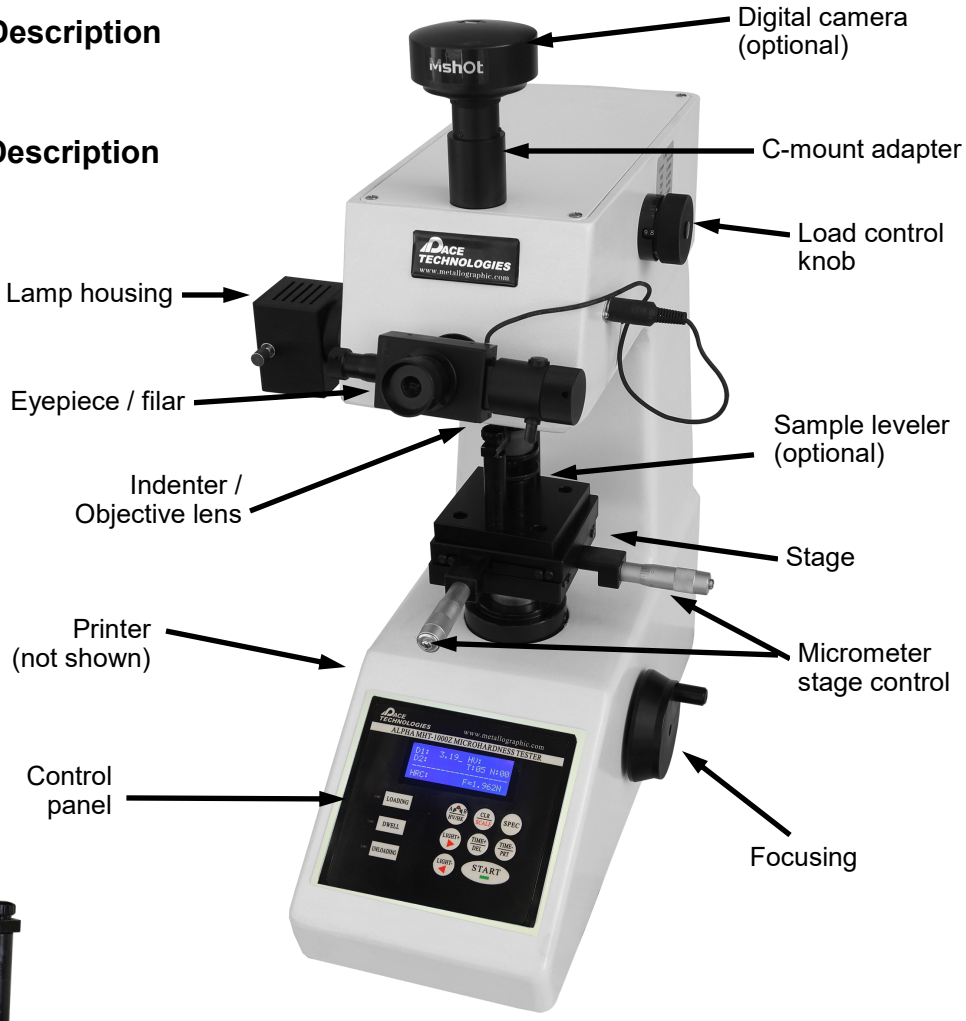
1.0 Product Description

1.1 General Description



Sample Leveler (optional)

The HV-1000Z is a Microhardness tester for testing metallographic specimens.

The HV-1000Z is a variable load Microhardness tester with a load range of 10 grams to 1000 grams and has a auto turret for switching between the indenter and the objectives.

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1.2 Technical Specifications

Electrical specifications:	220V single-phase (50/60 Hz)
Test forces:	0.098N(10gf) 0.245N(25gf) 0.49N(50gf) 0.9807N(100gf) 1.961N(200gf) 2.942N(300gf) 4.903N(500gf) 9.807N(1000gf)
Magnification:	100X, 400X
Dwell time of test force:	1-60 seconds
Max. height of specimen:	65 mm (2.6-inches)
Loading:	Automatic loading and unloading
Weight:	Approx. 55 lbs (25 kg)
Dimensions (WxHxD):	Approx. 16.5” x 7” x 18.5” (420 mm x 180 mm x 470 mm)
Working temperature:	70° - 85°F (23 - 28°C)

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2.0 Unpacking, Shipping and Installation

2.1 Unpacking

Unit is delivered in a box. Unpack and check for completeness of parts.

Measures WxHxD: 21”x17”x21” (530x430x530 mm)

Weight: Approximately 75 lbs (35 kg)

2.2 Shipping

When moving box, lift with handles.

! **Caution:** Heavy equipment. Take care to avoid bodily injury.

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2.3 Installation

! Install unit carefully! Improper installation voids warranty.

The ***HV-1000Z*** should be placed on a flat stable vibration free surface.
.

2.3.1 Remove shipping securing string and tape

Remove shipping ties

Remove indenter securing tape

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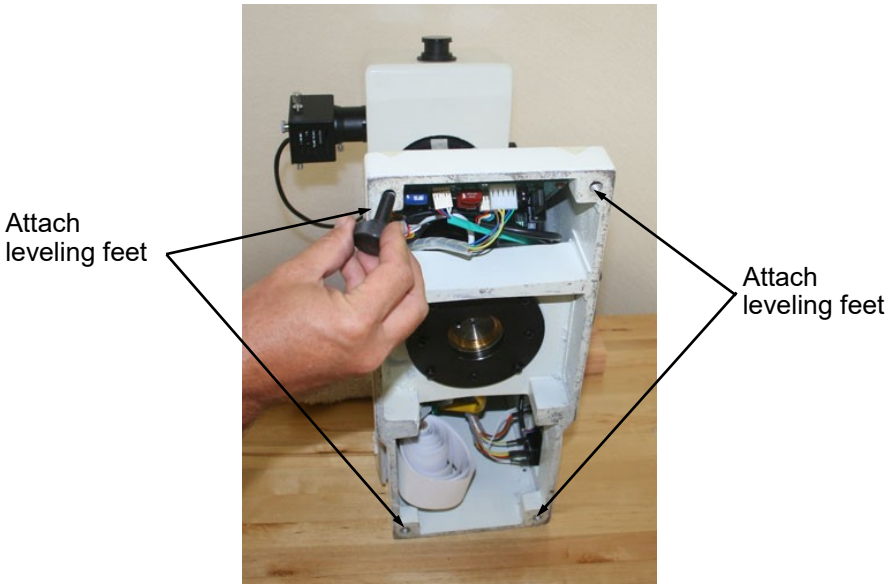
2.3.2 Install leveling feet



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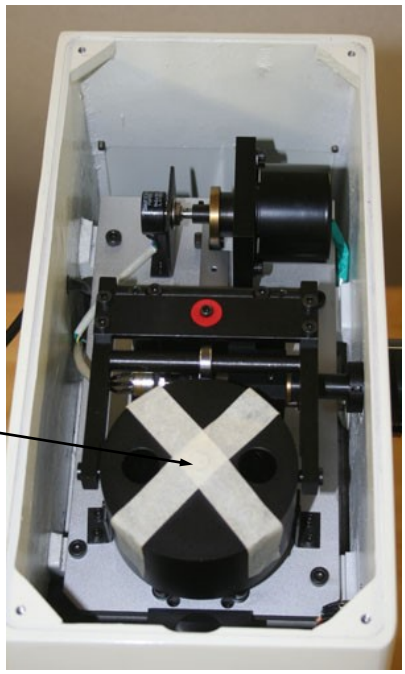
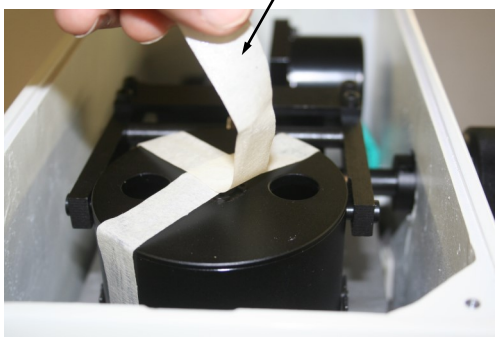
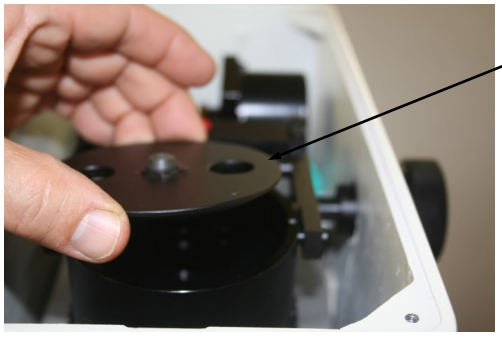
2.3.3 Remove shipping securing tape from weight holder



Remove shipping tape





Remove weight stack cover

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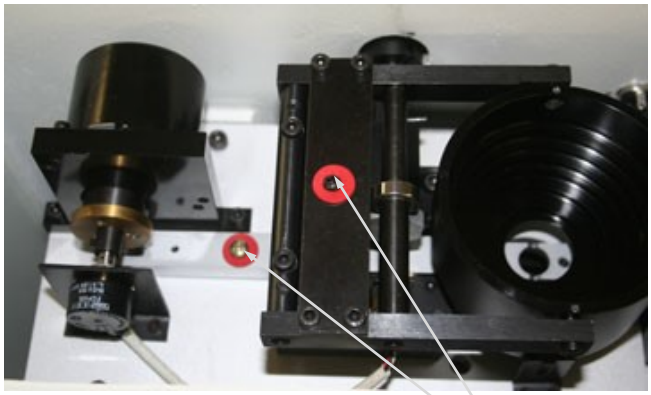
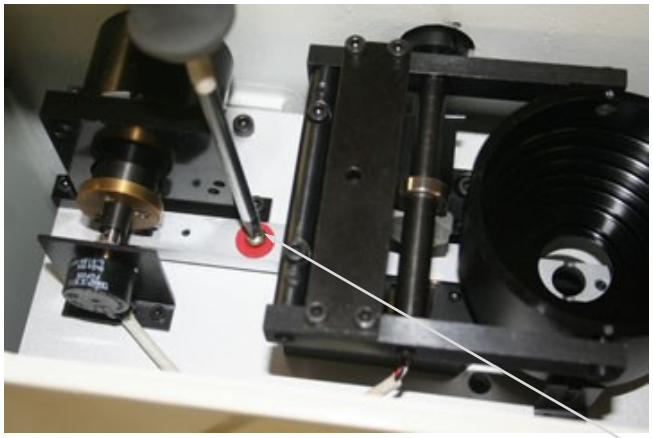
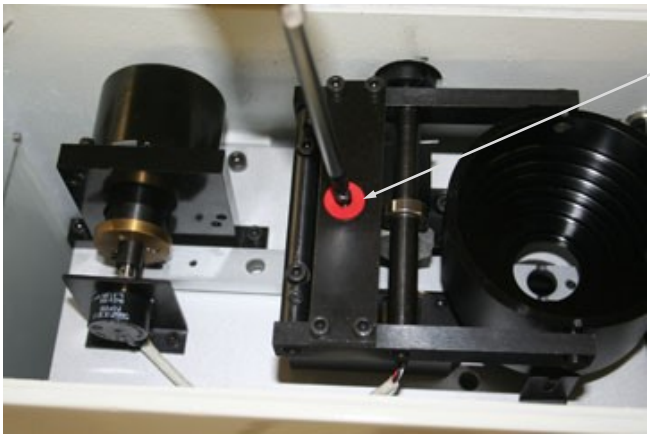
2.3.4 Remove shipping securing screws for Loading lever



Shipping securing screws





Remove shipping securing screws

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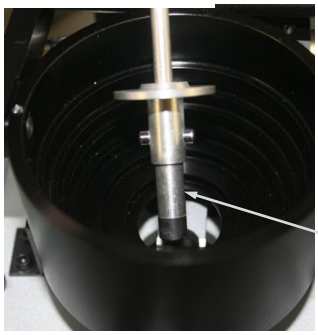
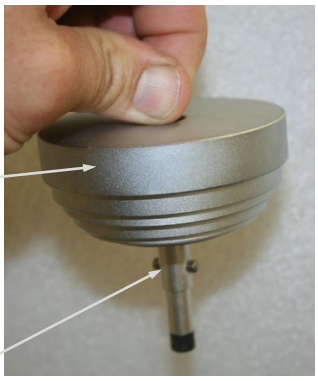
2.3.5 Weight load stack



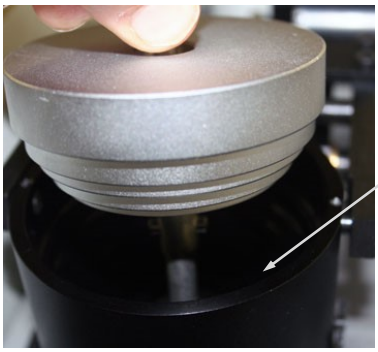
Weight stack

Weight holder



Weight holder with stack of weights

2.3.5.1 Installing weight stack

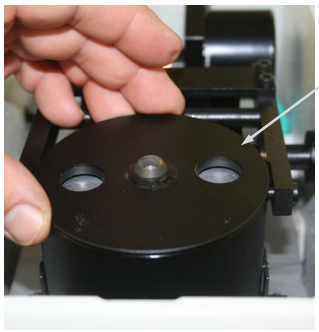


Align weight stack so that it fits into groove at the bottom of the holder

-Rotate to make sure it is in place

Test load selector knob to make sure it rotates freely

Replace weight stack cover



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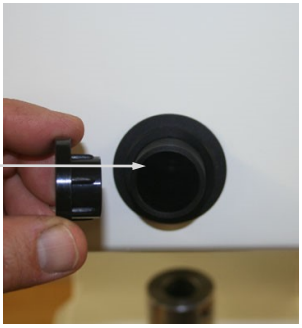
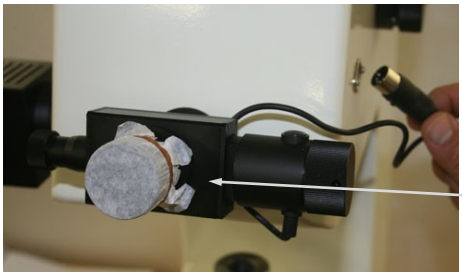
2.3.6 Installing filar eyepiece



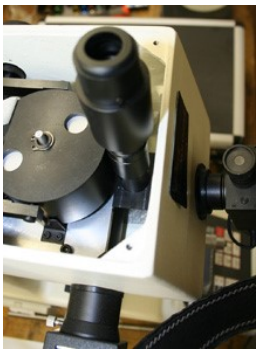
Remove cap from eyepiece tube



Attach filar eyepiece / measurement device

Plug in communication cable

2.3.7 Installing camera



-Insert c-mount adapter into port and attach camera.

To center image in camera the following adjustment may need to be made by moving lever shown. First remove filar and unscrew lens, lever is inside.

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2.3.8 Installing stage

Lower stage height and attach stage

Tighten set screw

2.3.9 Leveling unit

Place bubble level on stage and adjust feet height to level the unit

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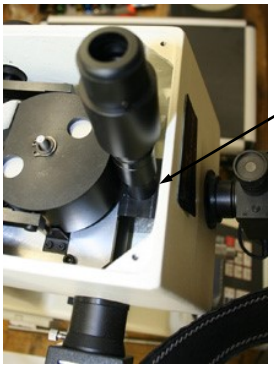
2.3.10 Installing digital camera (optional)

- Remove MHT top panel.
- Remove plastic cover on lens splitter
- Screw in camera adapter
- Replace MHT cover plate
- Screw on camera



Remove plastic cover and screw in camera adapter

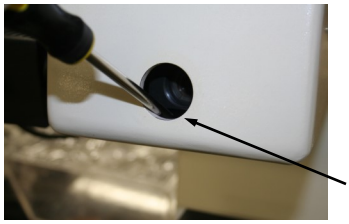
Remove plastic cover and screw in camera adapter

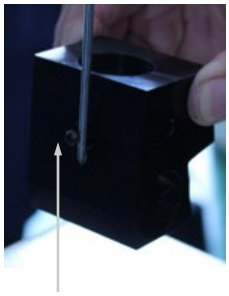
Screw on camera

2.3.10.1 Aligning light path for camera

- If the light path for the camera is off center it can be adjusted by adjusting the angle of the prism
- Remove filar
- Unscrew eyepiece lens
- With a screwdriver move lever left or right to adjust

Remove filar and unscrew eyepiece lens





Camera / eyepiece splitter prism adjustment (prism shown out of unit above)

2.3.10.2 Focusing Digital camera to filar eyepieces

- Focus through filar eyepieces
- Adjust focal length of camera adapter to match focus

Loosen locking nut and adjust focal length, tighten to lock in place

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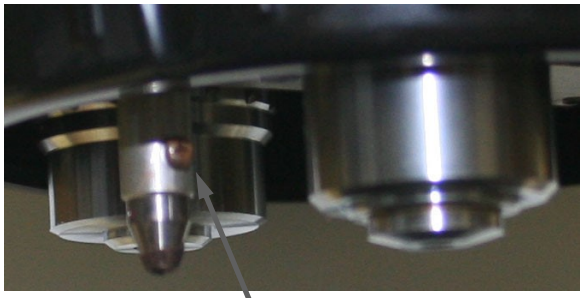
2.3.11 Replacing Indenter



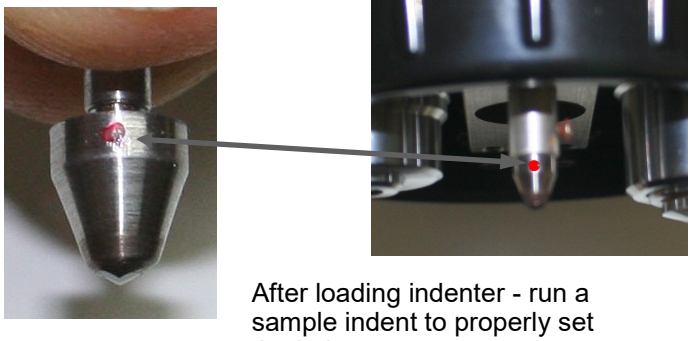
Loosen screw and remove indenter

2.3.11.1 Remove Indenter

2.3.11.2 Install Indenter

With turret in the indenting position (indenter forward)

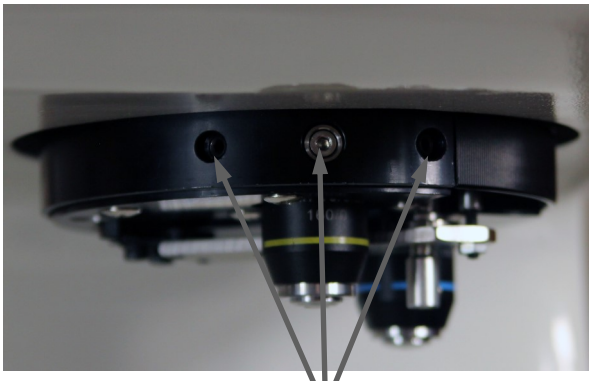
-Align red dot on indenter so it is facing forward for proper alignment (note for Knoop indenters the some additional adjustment may be required to align the indenter



After loading indenter - run a sample indent to properly set the indenter

2.3.11.3 Aligning the indenter with the objectives

To align the indenter with the objective there are three set screws on the objective.
-remove the turret plastic cover (three screws)
-Adjust the set screws (note if the indenter is too far off it may need to be rotated in 90 degree increments for Vickers or 180 degrees for Knoop



Adjustment set screws - may require loosing one side while tightening the other

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2.3.12 Calibrating Measurements

The unit has been calibrated before shipment, however, if it is necessary to recalibrate the unit the magnification of the image (optics) will need to be changed.
Prior to adjusting the optics it is recommended that the following be checked first:

1. Verify that the filar is pushed all the way into the light tube
2. Verify that the light tube is not loose (turn clockwise to tighten)
3. Verify that the unit level (use bubble leveler)
4. Verify that the load stack is hanging free and weight stack arm crossbar is positioned in the loading arm slot
5. Check that the indenter is not binding in its holder.
6. Focus the eyepiece so the filar lines are in sharp focus.

2.3.12.1 Calibrating Procedure

Step 1. remove filar from light tube

Step 2. remove light tube cover plate

Step 3. Unscrew light tube

Step 4. Adjust sleeve on light tube.

Example:
To increase the measured hardness turn the locking ring clockwise so the tube threads deeper into the prism (shorter tube length). As an approximation 1/2 turn of the ring changes the measured value by about 2% (1000 gram load, 1/2 turn increased hardness from 405-415)

Step 5. reverse procedure to reinstall and retest hardness.
Repeat procedure until calibrated.

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3.0 Safety Guidelines

3.1 Warning Sign

! This sign points to special safety features on the machine.

3.2 Safety Precautions

! Careful attention to this instruction manual and the recommended safety guidelines is essential for the safe operation of the ***HV-1000Z***.

! Proper operator training is required for operation of the ***HV-1000Z***. Any unauthorized mechanical and electrical change, as well as improper operation, voids all warranty claims. All service issues need to be reported to the manufacturer / supplier.

! Operate unit as specified in this manual.

! Disconnect power before opening unit.

! Lower stage to avoid damaging indenter or lens when not in use.

! Cover unit with dust cover when not in use to eliminate dust contamination.

3.3 Emergency Statement

Always follow proper operational guidelines and avoid contact with lubricants and abrasives.

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4.0 Operation

STEPS FOR HV-1000Z OPERATION IN BRIEF
(Please see explanation of important points on next pages before proceeding)

1. Mount the sample so it is flat on the stage. For non-parallel mounts a leveling vice is recommended (optional)

2. Turn on the HV-1000Z (allow the auto turret to calibrate itself before beginning any operation). Focus on an edge of the sample and then move to the location for the indentation, Adjust intensity of light (L– and L+), set Filar to ZERO (press CLR to zero), select the Load and enter the Dwell Time

3. Press Start to make Indentation. Note: The auto turret will automatically rotate the indenter into place, apply the load and then rotate back to the 40X objective.

4. Measure D1 / D2 (for Vickers) (PRESS BUTTON ON FILAR TO ACCEPT), rotate the Filar micrometer counter-clockwise, measure D2 (PRESS BUTTON ON FILAR TO ACCEPT), and the rotate to original position clockwise). For Knoop measure only the major axis, D1 is measured (PRESS BUTTON ON FILAR TO ACCEPT). NOTE THE FIRST INDENT IS NOT RECORDED INTO MEMORY AS IT IS COMMON PRACTICE FOR THE FIRST INDENT TO BE USED TO SET THE INDENTOR.

5. Note the HV or HK value

6. If the measurement is bad, press (DEL) and re-measure indent.

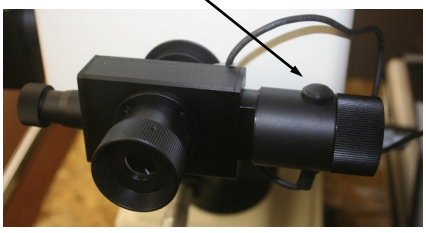
7. If more impressions need to be taken, move stage to relevant location and go to step 3

8. PRT to print results or to send to Hyper Terminal

9. Lower stage and remove the sample and/or leveling vice. Switch the instrument off.

Sample Leveler
(optional)

Measurement button



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PRECAUTIONS

Clamp the sample properly on the self-leveling vice. This will make the sample exactly perpendicular to the indenter.

Important : This is very important as a tilted sample can damage the indenter. it is also very important to have a flat specimen. A rounded specimen will have varying height as it moves and can touch and damage the indenter.

The stage should be at its lowest position before placing the leveling vice on the stage. The stage can be lowered to its lowest position by rotating the focusing handle in the counter-clockwise direction.

Important : Take utmost care to insure that the sample or the leveling vice does not touch the indenter or the optics as this may damage the indenter

Switch on the HV-1000Z and focus the specimen under 10x objective (Care should be taken to see that the indenter is not touching any part of the sample or the leveling vice when you index the indenter / objective)

Important : When raising the stage to get the sample in focus, always look at the sample as it is raised from the side (NOT from the eyepiece) and stop raising it when there is a gap on approximately 0.1 mm between the sample and the objective

Index the indenter over the sample (Care should be taken to insure that the indenter is not touching any part of the sample or the self leveling vice when you index the indenter / objective)

Next swing the 40x objective into place and make sure that the indenter again does not touch anything when being indexed. Focus if necessary

Important : When raising the stage to get the sample in focus, always look at the sample as it is raised from the side (NOT from the eyepiece) and stop raising it when there is a gap on approximately 0.1 mm between the sample and the objective tip. Then view through the eyepiece and lower the stage to do the fine focusing

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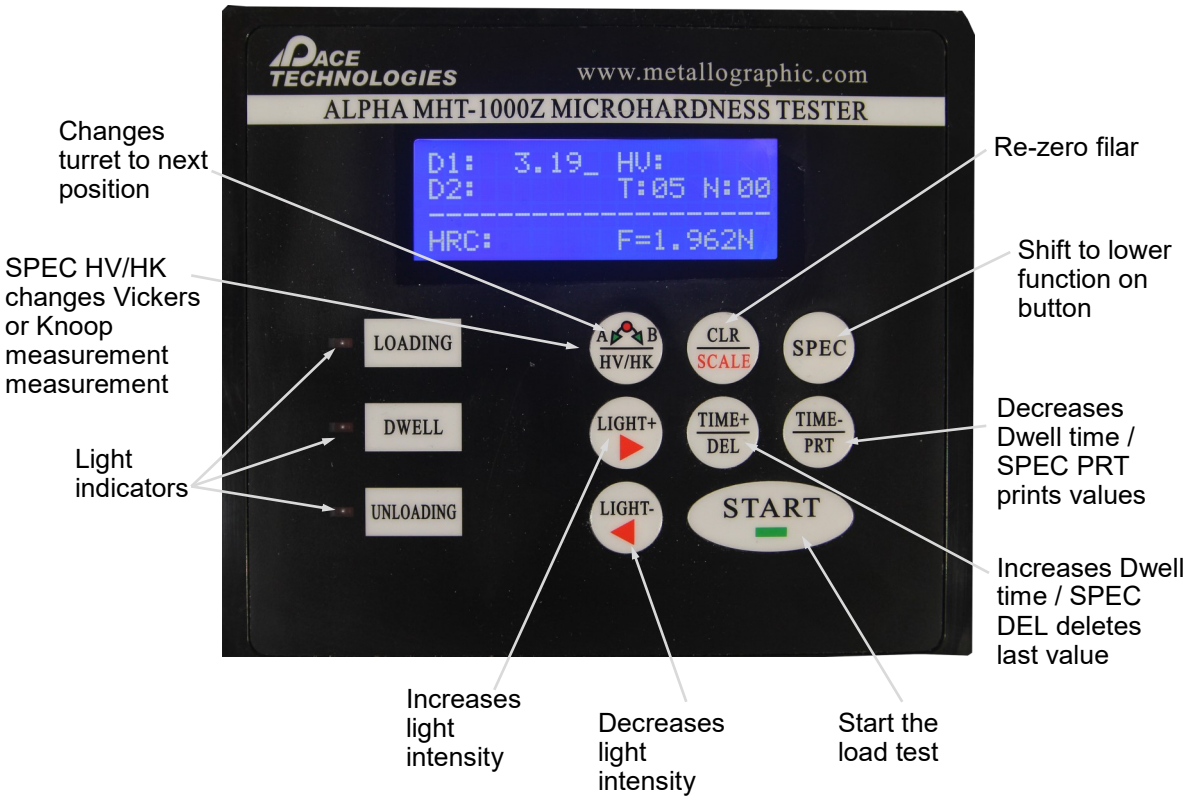
4.1 Control Panel



Setting DATE: To set the date, immediately after the date shows on the display after the WELCOME, press the TIME+ or TIME– key. Set the year and press SPEC TIME+ , set the month, press SPEC TIME+ to adjust the day. To exit date field press SPEC.

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CLR	The CLR key is used to reset the filar to zero
PRT	The PRT key is used to print or connect the interface; the key serves to print the data of the present test or send them to the COM interface of a PC through RS232. Note: see Appendix for setting up Hyper Terminal to PC
L+	The L+ key is used to increase the intensity of the light. A continuous tone indicates the maximum intensity has been reached.
L-	The L– key is used to reduce the intensity of the light. A continuous tone indicates that the intensity of the light is at a minimum.
START	The START key is used to begin the test
DEL	Delete's entry after the measurement has been made. Note you must enter a value with the button on the filar before you DEL. Otherwise you will not be able to continue.

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5.0 Maintenance

5.1 Introduction

The ***HV-1000Z*** requires very minimal maintenance. However, to increase the life of the Microhardness tester, it is suggested that the unit be covered when not in use.

5.2 Cleaning outside cabinet

The cabinet should be cleaned occasionally with a moistened cloth. Do not use any chemicals or cleaning abrasives.

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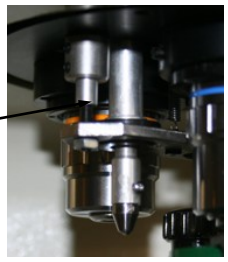
6.0 Trouble Shooting

More extensive trouble shooting, repair guides, video's, parts list are provided online at www.metallographic.com or

http://www.metallographic.com/PACE-service/MHT-service.html

Problem	Cause	Solution
No power or function	a. Unit is disconnected from main electrical power supply b. Main power switch is off c. Blown fuse	a. Verify electrical source and connection. b. Turn on main power switch. c. Replace fuse
Indenter does not move	a. Unit needs to be reset b. Internal damage	a. Turn off power and restart b. Call service center.
Chipped indent	Broken indenter	Replace indenter
Indenter not in alignment with objective	Objective not centered on indenter	-Align objective -If grossly out of alignment the indenter may need to be rotated in 90 degree increments for Vickers and 180 degrees for Knoop indenters
Indent not symmetric	Indenter may need to be rotated	-Rotate indenter 90 degree increments for Vickers and 180 degrees for Knoop indenters
Indenter not indenting properly	Indenter balancing pin out of position (see image below)	-Place dislodged part back into position (see below)

Align this into position



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7.0 Spare Parts

Part no.	Description	Image
	Electrical components	
MNT-1050	HV-1000Z control board	
MHV2-E-CB	MHV-2000 control board	
MHT-010	MHT driver control board	
MHT-011	MHT driver control input board	
MHT-012	MHT indenter motor	
MHT-013	MHT turret motor	
MHT-014	MHT 110/220 volt transformer	

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Part no.	Description	Image
	Electrical components	
MHT-E-LH	MHT lamp housing	
MHT-Bulb	MHT light bulbs (each)	
811-881	PC-RS232 software cable	
811-882	PC RS-232 to USB software cable	
MHT-E-PRI	MHT Printer-1	
MHT-PRI2	MHT Printer-2	
CORD-110	110V USA power cord	
CORD-220R	220V round prong power cord	
CORD-220F	220V flat prong power cord	

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Part no.	Description	Image
	Optical components	
MHT-001	MHT filar eyepieces	
823-311	MHT-10X objective	
823-331	MHT-40X objective	

Part no.	Description	Image
	Camera components	
823-361	MHT 1X camera adapter (c-mount)	
MP50	5 MP digital camera	
Microhardness-Pro	Microhardness Pro software for measuring indent size	

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Part no.	Description	Image
	Camera components	
MHT-003	MHT X-Y table w/o micrometers	
MHT-ENG	MHT micrometers (English units) (2/set)	
MHT-MET	MHT micrometers (Metric units) (2/set)	
MHT-M-VI	Vickers Indenter	
MHT-M-KI	Knoop Indenter	
MHT-M-IRS	Indenter retention screw	
MHV-S	Precision screw feed height adjustment unit for microhardness testers	
MHT-M-HAW	Height adjustment wheel	
MHT-FEET	MHT feet (4/pkg)	
823-902	Dust cover for MHT	

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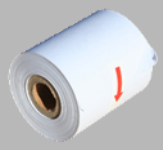
Part no.	Description	Image
	Camera components	
811-100-1	Printer paper rolls for MHT-1 printer (2.25-inch width)	
811-100-2	Printer paper rolls for MHT-2 printer (1.75-inch width)	
MHT-P-TPC	Turret plastic cover	
MHT-2000-W	MHV-2000 additional 1000 gram weight	
MHT-W	10 to 1000 gram weight stack for MHT testers	
MHT-ROD	Weight stack holder for MHT testers	

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Part no.	Description	Image
	Fixturing vises	
823-741	MHT sample leveler	
MHT-BUB	Bubble Level	
MHT-004	MHT Fork-shaped test table	
MHT-005	MHT Thin specimen test table	
MHT-006	MHT Fine wire test table	

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8.0 Microhardness Testing Basic

Microhardness testers are both mechanical and optical measuring tools. The indent is produced by applying a known load to the specimen and then measuring the size of the appropriate diagonals either optically or with image analysis software.

Microhardness is primarily determined with either a Knoop or Vickers indenter under test loads in the range of 1 to 2000 gram-force. Microhardness is used to measure the hardness of specific phases, small particles, and for brittle materials. Figure 6-1 shows the Knoop microhardness indents for a heat treated steel specimen.

Knoop hardness (HK) number is based on the size of the indent that a rhombic-based, pyramidal diamond indenter produces under a known applied load. The HK number is calculated by dividing the applied load (kilogram-force) by the projected area of the indentation (square millimeters).

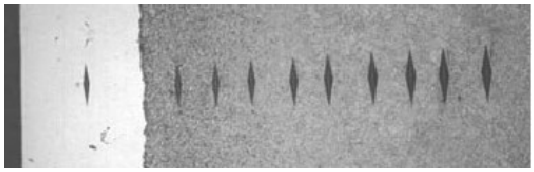

Figure 6-1 Knoop hardness indents in a hardened steel.

The Vickers hardness (HV) number is obtained by dividing the applied load in kilogram-force by the surface area of the indentation. The area of the indentation produced from the Vickers square-based pyramidal diamond is determined by the mean distance between the two diagonals of the indentation (Figure 6-2).

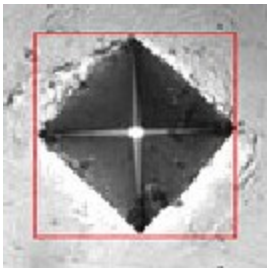

Figure 6-2 Vicker indent.