



3601 E. 34th St. Tucson, AZ 85713 USA Tel. +1-520-882-6598 Fax +1-520-882-6599 email: [pace@metallographic.com](mailto:pace@metallographic.com) Web: <http://www.metallographic.com>



Equipment Type: Microhardness Tester  
(Vickers and Knoop)  
Model: **ALPHA MHT-2000Z2**  
Electrical Requirements: 110/220 Volts  
(single-phase)  
Frequency: 50/60 Hz  
Manual Revision Date: April 24, 2022

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



# **ALPHA MHT-2000Z2**

## **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: <http://www.metallographic.com>

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



## Contents

	PAGE
<b>Warranty</b>	ii
<b>1.0 Product Description</b>	1
<b>2.0 Unpacking, Shipping and Installation</b>	3
<b>3.0 Safety Guidelines</b>	14
<b>4.0 Operation</b>	15
<b>5.0 Maintenance</b>	24
<b>6.0 Trouble Shooting</b>	25
<b>8.0 Microhardness Testing Basics</b>	26
<b>9.0 Appendix MHT measurement software (optional)</b>	27

## WARRANTY

### Terms and Conditions applying to all PACE Technologies Products

#### 1. LIMITED WARRANTY AND DISCLAIMER:

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.

PACE TECHNOLOGIES MAKES NO EXPRESS WARRANTIES OTHER THAN THOSE WHICH ARE SPECIFICALLY DESCRIBED HEREIN. Any description of the goods sold hereunder, including any reference to Buyer's specifications and any description in catalogs, circulars and other written material published by PACE Technologies, is the sole purpose of identifying such goods and shall not create an express warranty that the goods shall conform to such description.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. THERE ARE NO IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE. THIS WARRANTY STATES PACE TECHNOLOGIES ENTIRE AND EXCLUSIVE LIABILITY AND BUYER'S EXCLUSIVE REMEDY FOR ANY CLAIM FOR DAMAGES IN CONNECTIONS WITH PACE TECHNOLOGIES PRODUCTS. PACE TECHNOLOGIES WILL IN NO EVENT BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES WHATSOEVER, NOR FOR ANY SUM IN EXCESS OF THE PURCHASE PRICE.

#### 2. LIABILITY CAP:

PACE Technologies maximum aggregate liability for loss and damage arising under, resulting from or in connection with the supply or use of the Equipment and Consumables provided under this purchase, or from the performance or breach of any obligation (s) imposed hereunder, whether such liability arises from any one or more claims or actions for breach of contract, tort, (including negligence), delayed completion, warranty, indemnity, strict liability or otherwise, unless otherwise limited by the terms hereof, shall be limited to one hundred percent (100%) of the purchase price.

#### 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.

**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:**

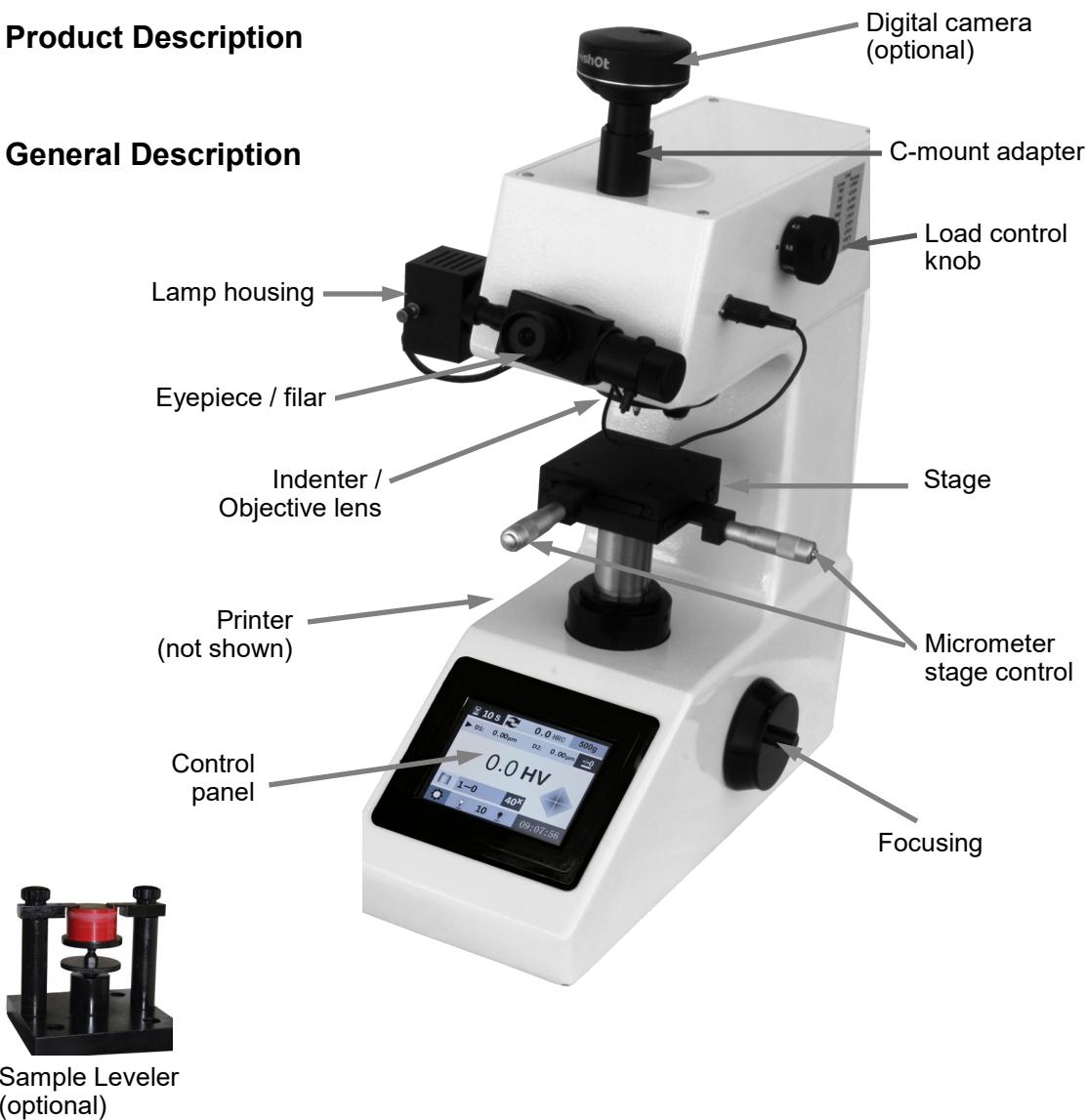
This agreement has been made in and shall be governed by the laws of the State of Arizona. These terms and conditions and the description of the Products on the reverse side hereof or in any proposal submitted herewith constitute the entire agreement and understanding of the parties with respect to this 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.

## 1.0 Product Description

### 1.1 General Description



The ALPHA-MHT-2000Z2 is a Microhardness tester for testing metallographic specimens.

The ALPHA-MHT-2000Z2 is a variable load Microhardness tester with a load range of 10 grams to 2000 grams and has a auto turret for switching between the indenter and the objectives.



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

## 1.2 Technical Specifications

Electrical specifications:	110/220V 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)

## 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.



3601 E. 34th St. Tucson, AZ 85713 USA Tel. +1-520-882-6598 Fax +1-520-882-6599 email: [pace@metallographic.com](mailto:pace@metallographic.com) Web: <http://www.metallographic.com>

## 2.3 Installation



Install unit carefully! Improper installation voids warranty.

The **ALPHA-MHT-2000Z2** should be placed on a flat stable vibration free surface.

### 2.3.1 Remove shipping securing string and tape

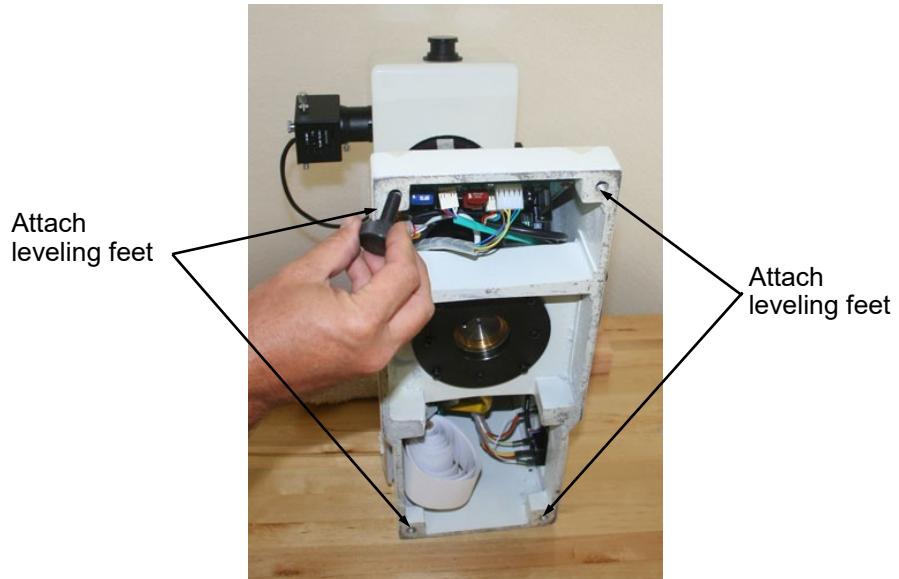
Remove shipping ties



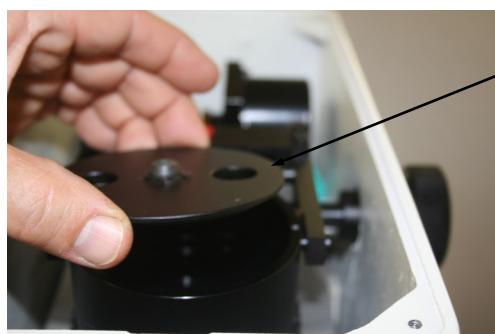
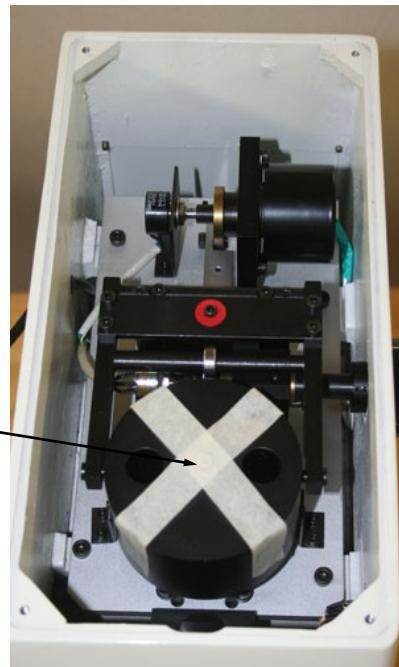
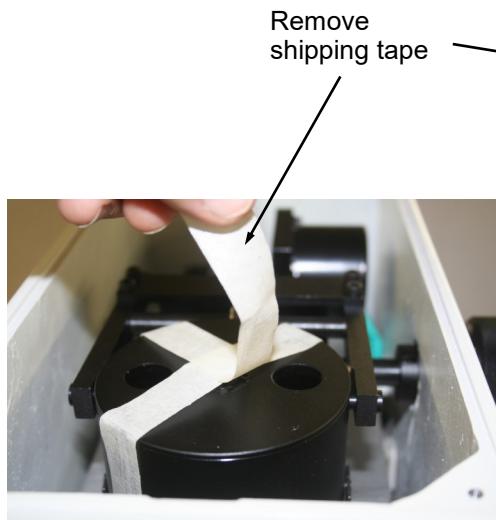
Remove indenter securing tape



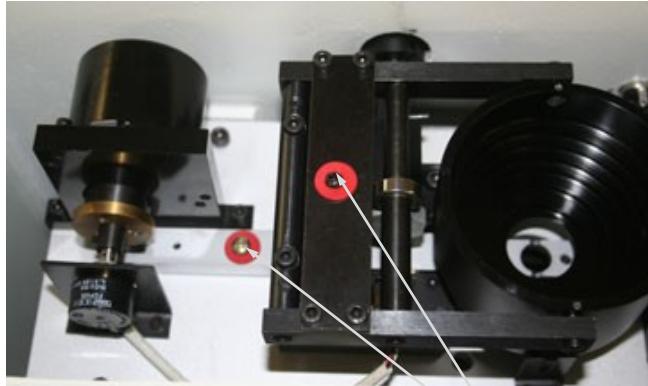
### 2.3.2 Install leveling feet



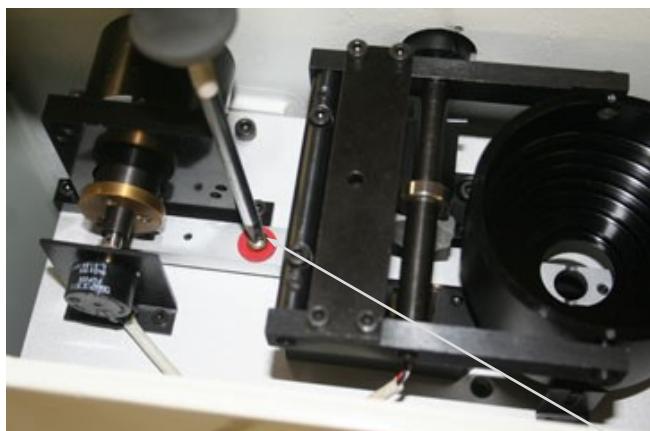
### 2.3.3 Remove shipping securing tape from weight holder



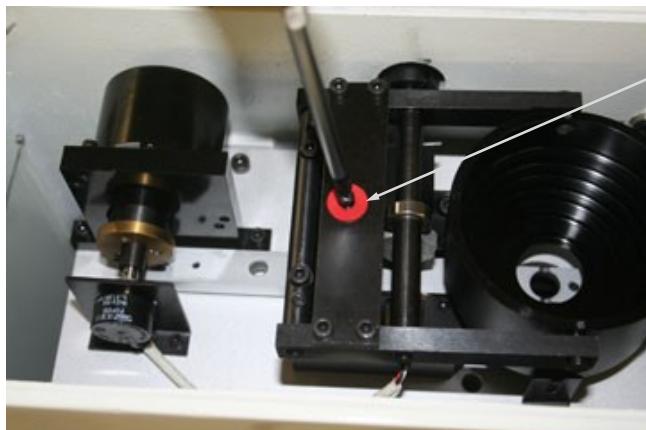
### 2.3.4 Remove shipping securing screws for Loading lever



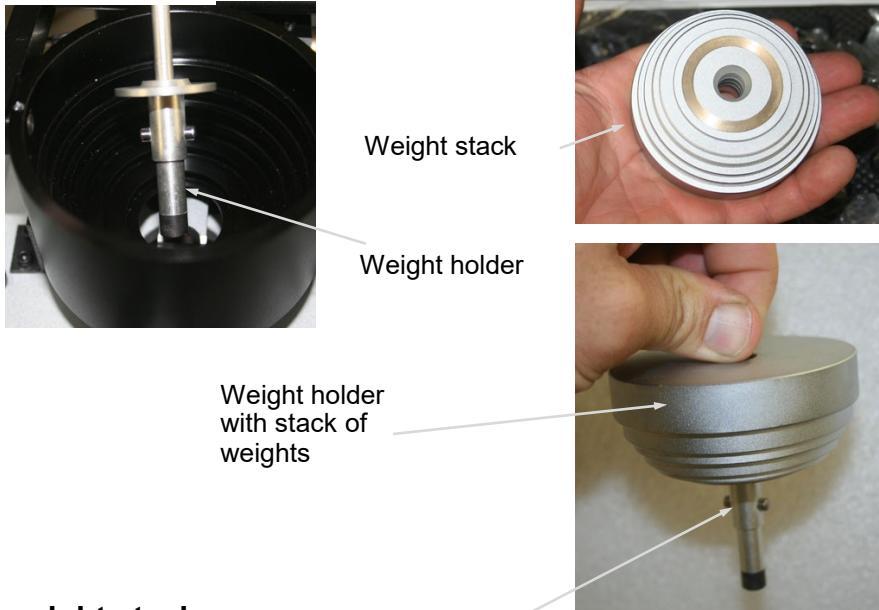
Shipping securing screws



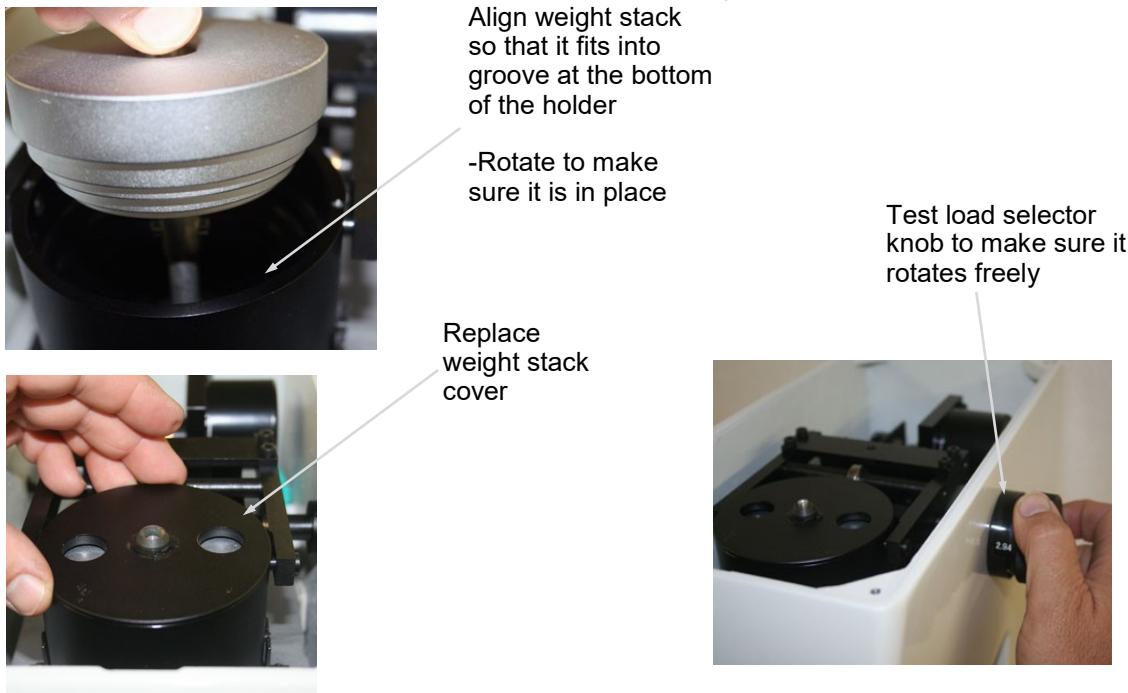
Remove shipping securing screws



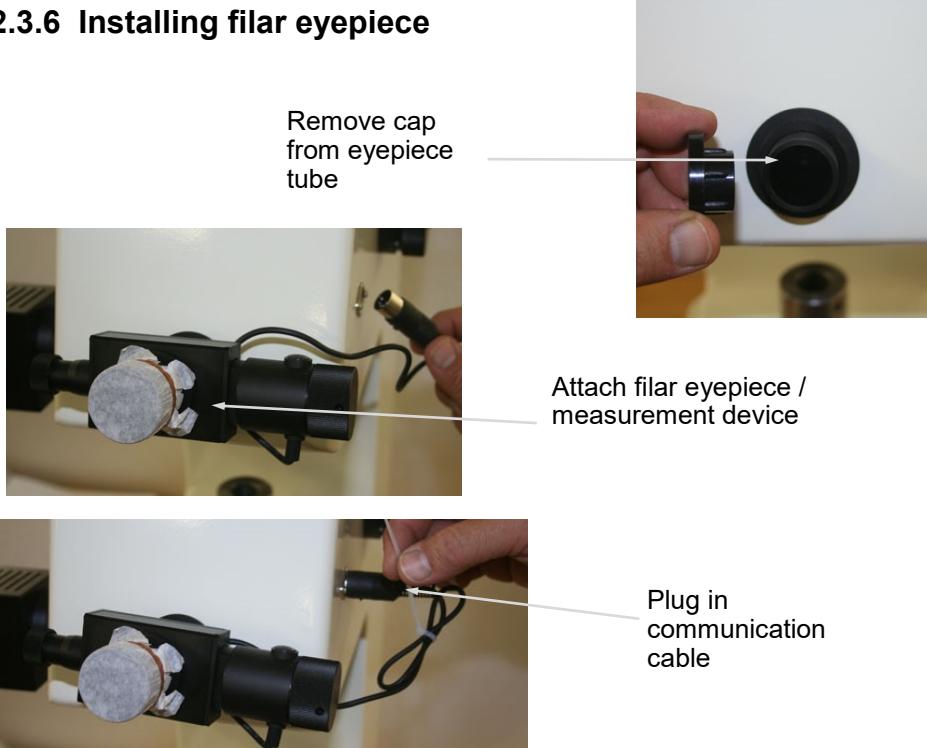
### 2.3.5 Weight load stack



#### 2.3.5.1 Installing weight stack



### 2.3.6 Installing filar eyepiece



### 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.



3601 E. 34th St. Tucson, AZ 85713 USA Tel. +1-520-882-6598 Fax +1-520-882-6599 email: [pace@metallographic.com](mailto:pace@metallographic.com) Web: <http://www.metallographic.com>

### 2.3.8 Installing stage

Lower stage height and attach stage



Tighten set screw



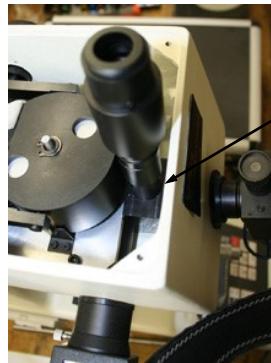
### 2.3.9 Leveling unit

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



### 2.3.10 Installing digital camera (optional)

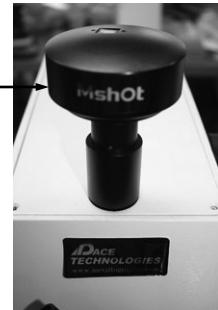
- Remove MHT top panel.
- Remove plastic cover on lens splitter
- Screw in camera adapter
- Replace MHT cover plate
- Screw on camera



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



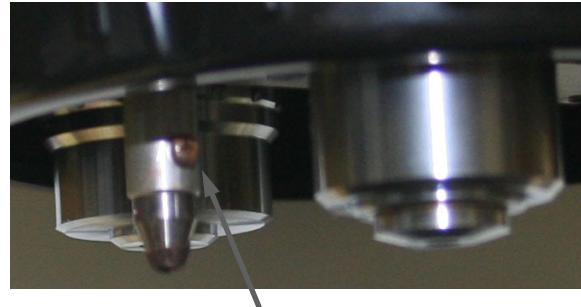
Loosen locking nut  
 and adjust focal  
 length, tighten to  
 lock in place



3601 E. 34th St. Tucson, AZ 85713 USA Tel. +1-520-882-6598 Fax +1-520-882-6599 email: [pace@metallographic.com](mailto:pace@metallographic.com) Web: <http://www.metallographic.com>

### 2.3.11 Replacing Indenter

#### 2.3.11.1 Remove Indenter

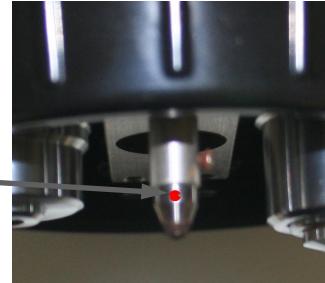


Loosen screw and remove indenter

#### 2.3.11.2 Install Indenter

With turret in the indenting position (indenter forward)

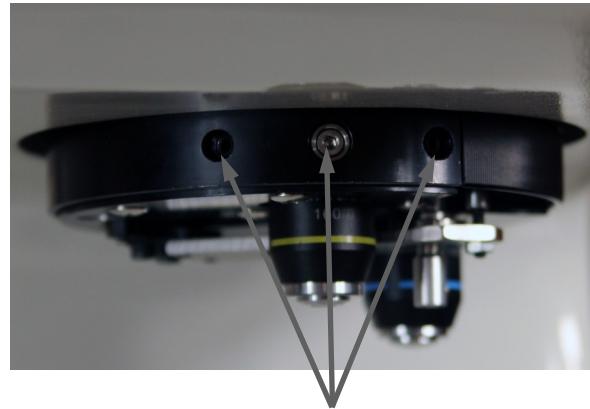
-Align red dot on indenter so it is facing forward for proper alignment (note for Knoop indenters the some additional adjustment may be required to align the indenter)



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 loosening one side while tightening the other

### 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.



3601 E. 34th St. Tucson, AZ 85713 USA Tel. +1-520-882-6598 Fax +1-520-882-6599 email: [pace@metallographic.com](mailto:pace@metallographic.com) Web: <http://www.metallographic.com>

### **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 **ALPHA-MHT-2000Z2**.
- !** Proper operator training is required for operation of the **ALPHA-MHT-2000Z2**. 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**

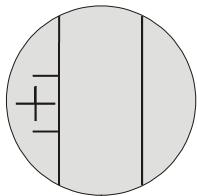
Always follow proper operational guidelines and avoid contact with lubricants and abrasives.

## 4.0 Operation

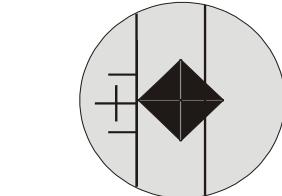
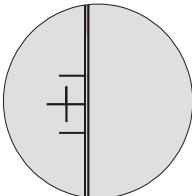
### STEPS FOR ALPHA-MHT-2000Z2 OPERATION IN BRIEF

(Please see explanation of important points on next pages before proceeding)

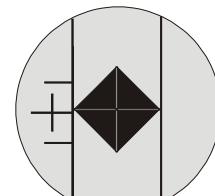
1. Mount the sample so it is flat on the stage. For non-parallel mounts a leveling vice is recommended (optional)
2. Turn on the ALPHA-MHT-2000Z2(allow the auto turret to calibrate itself before beginning any operation). Focus on an edge of the sample and then move to the location for the indentation, Adjust intensity of light, set Filar to ZERO, select the Load, indenter type, conversion scale (if required) and enter the Dwell Time. Select Folder in DATA MANAGEMENT menu to store results and to later print.
3. Press Ident Icon (picture) tart 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.



Zero filar by bringing both lines together so they barely touch.  
Zero value



Align left filar so inside of line barely touches left side of indent, rotate filar knob to just outside right edge of indent. Press



5. Note the HV or HK value
6. If the measurement is bad, press (CANCEL) and re-measure indent.
7. If more impressions need to be taken, move stage to relevant location and go to step 3
8. From VIEW screen select TOOLS to print results
9. Lower stage and remove the sample and/or leveling vice. Switch the instrument off.



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

## **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 ALPHA-MHT-2000Z2 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 )

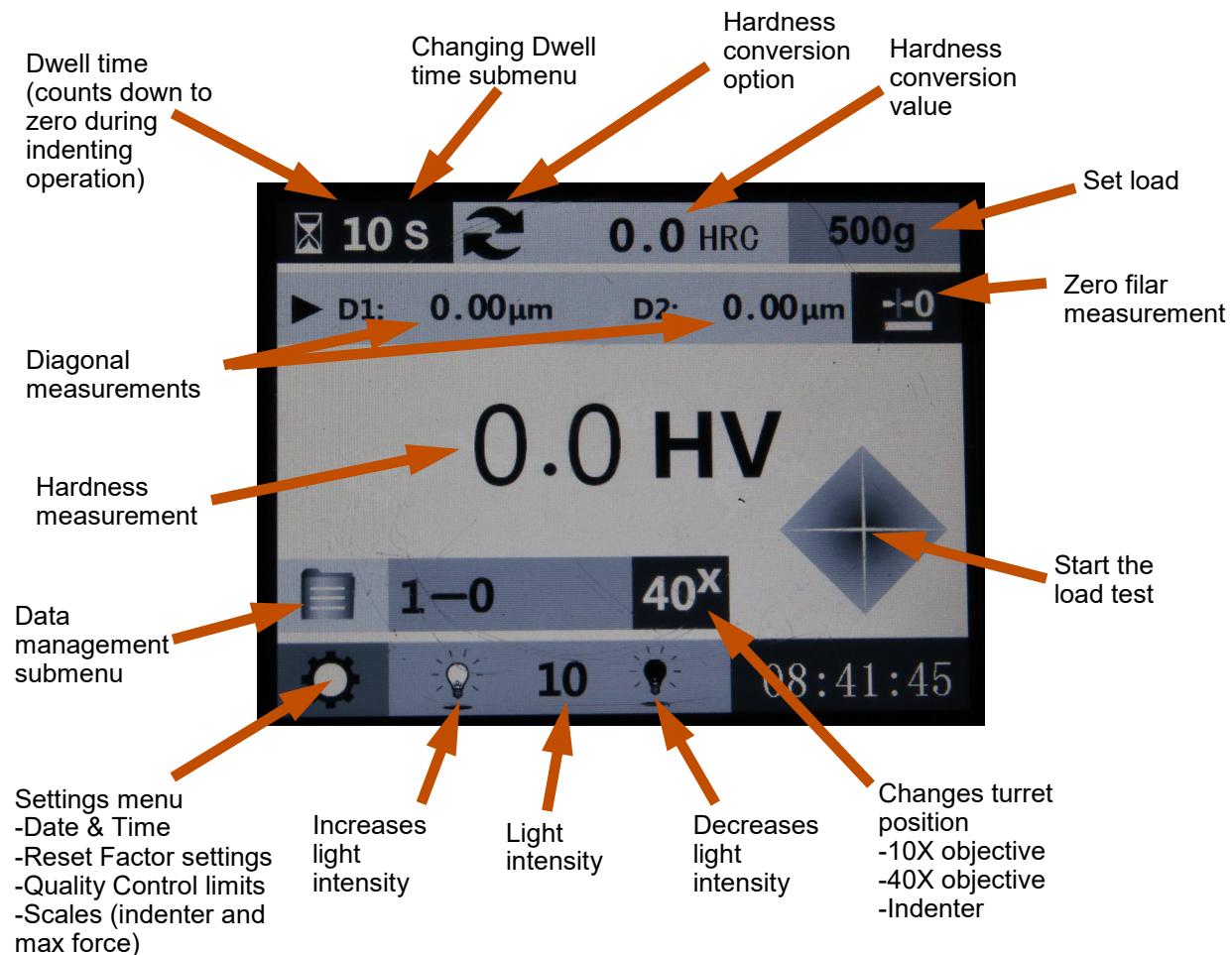
**Important :** When raising the stage to get the sample in focus, always look at the sample as it is raised from the side ( NOT from the eyepiece ) and stop raising it when there is a gap of approximately 0.1 mm between the sample and the objective

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 of 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

#### 4.1a Control Panel (main panel)

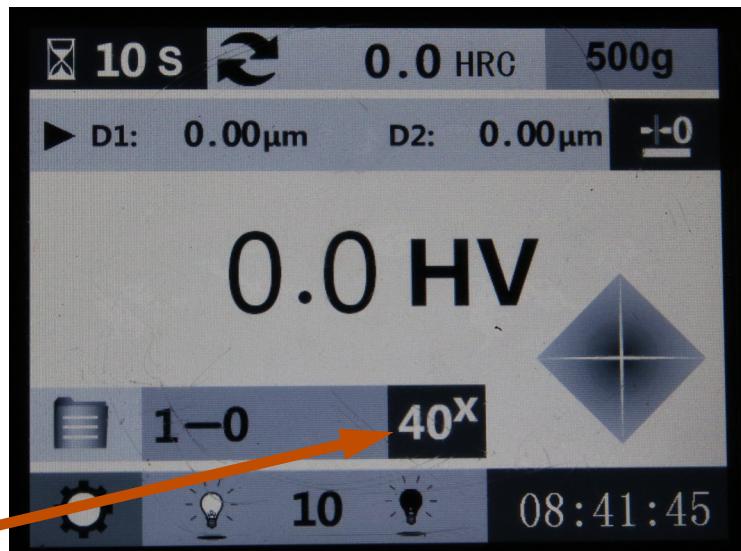




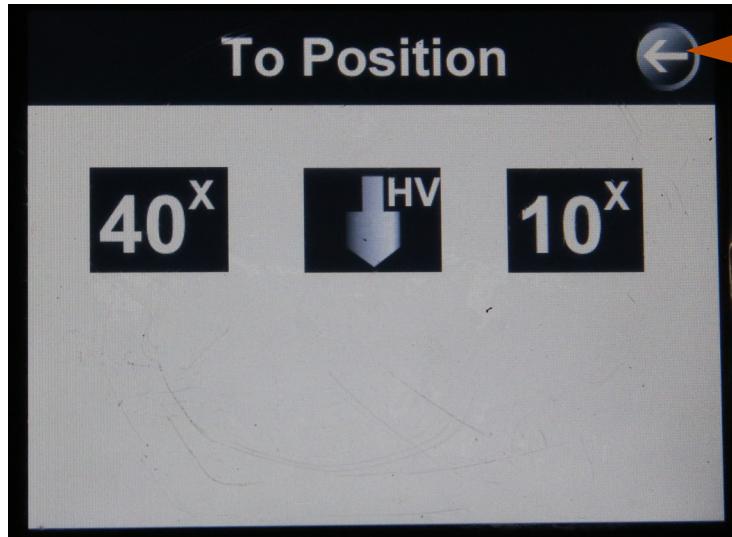
3601 E. 34th St. Tucson, AZ 85713 USA Tel. +1-520-882-6598 Fax +1-520-882-6599 email: [pace@metallographic.com](mailto:pace@metallographic.com) Web: <http://www.metallographic.com>

#### 4.1b Control Panel (Turret position)

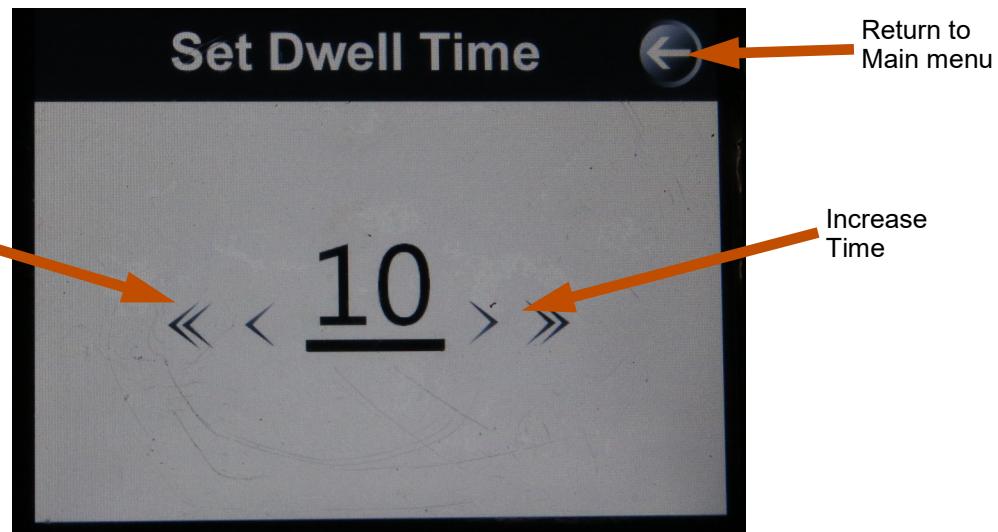
Changes turret  
position  
-10X objective  
-40X objective  
-Indenter



Return to  
Main menu



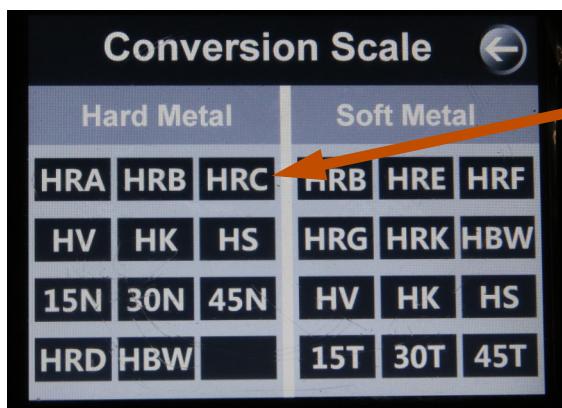
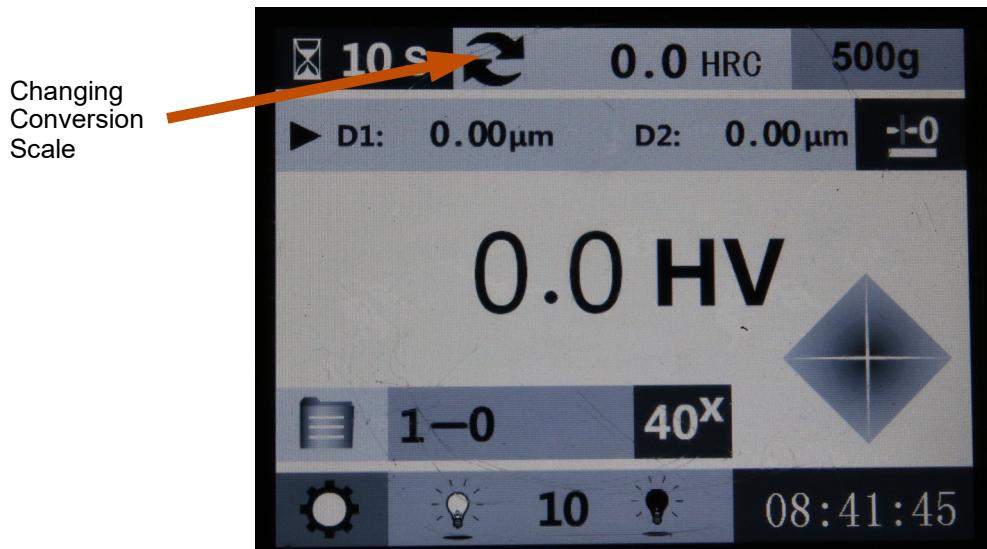
#### 4.1c Control Panel (Set Dwell Time)





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

#### 4.1d Control Panel (Scale Conversion)

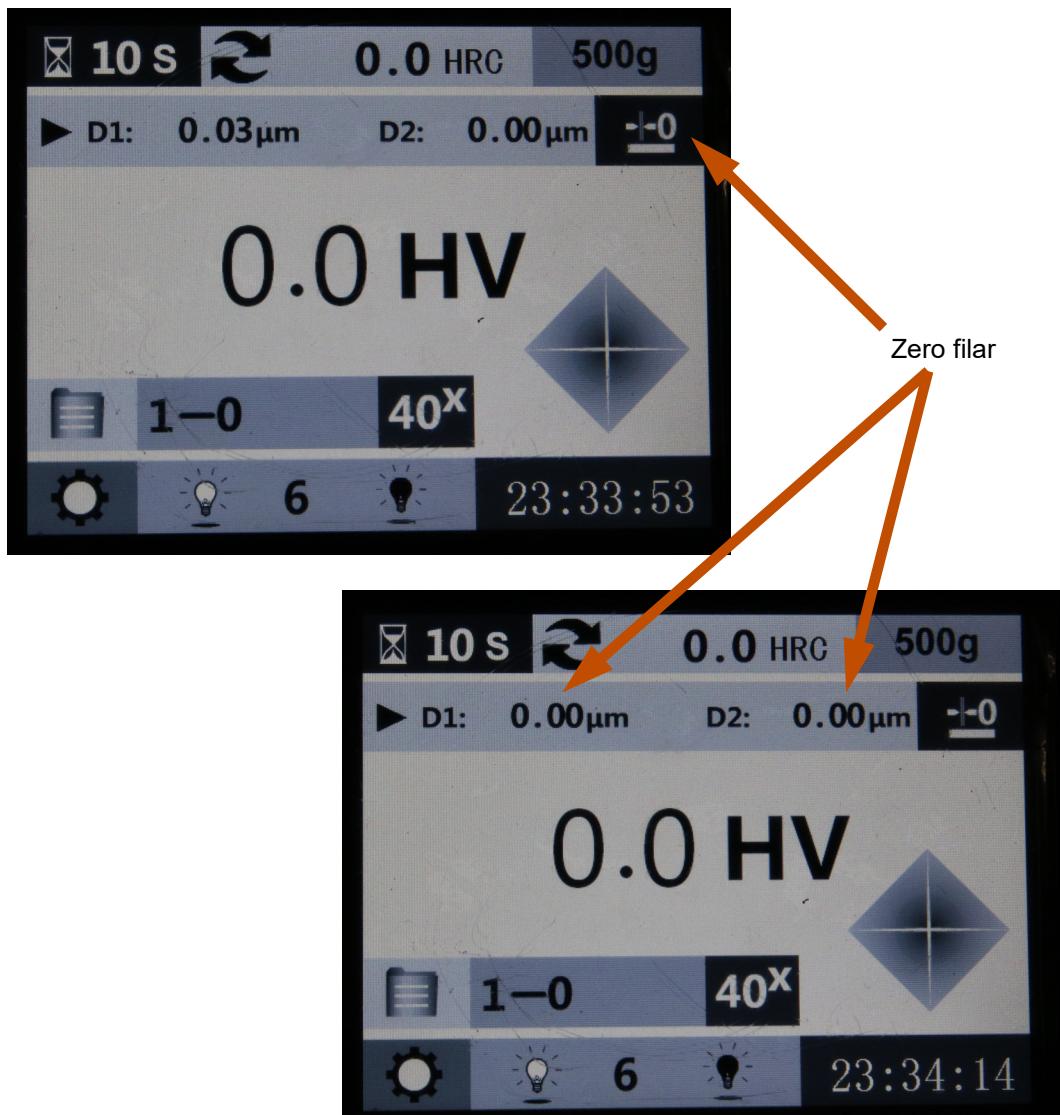


Select conversion scale

Displays conversion value



#### 4.1e Control Panel (Zero filar)



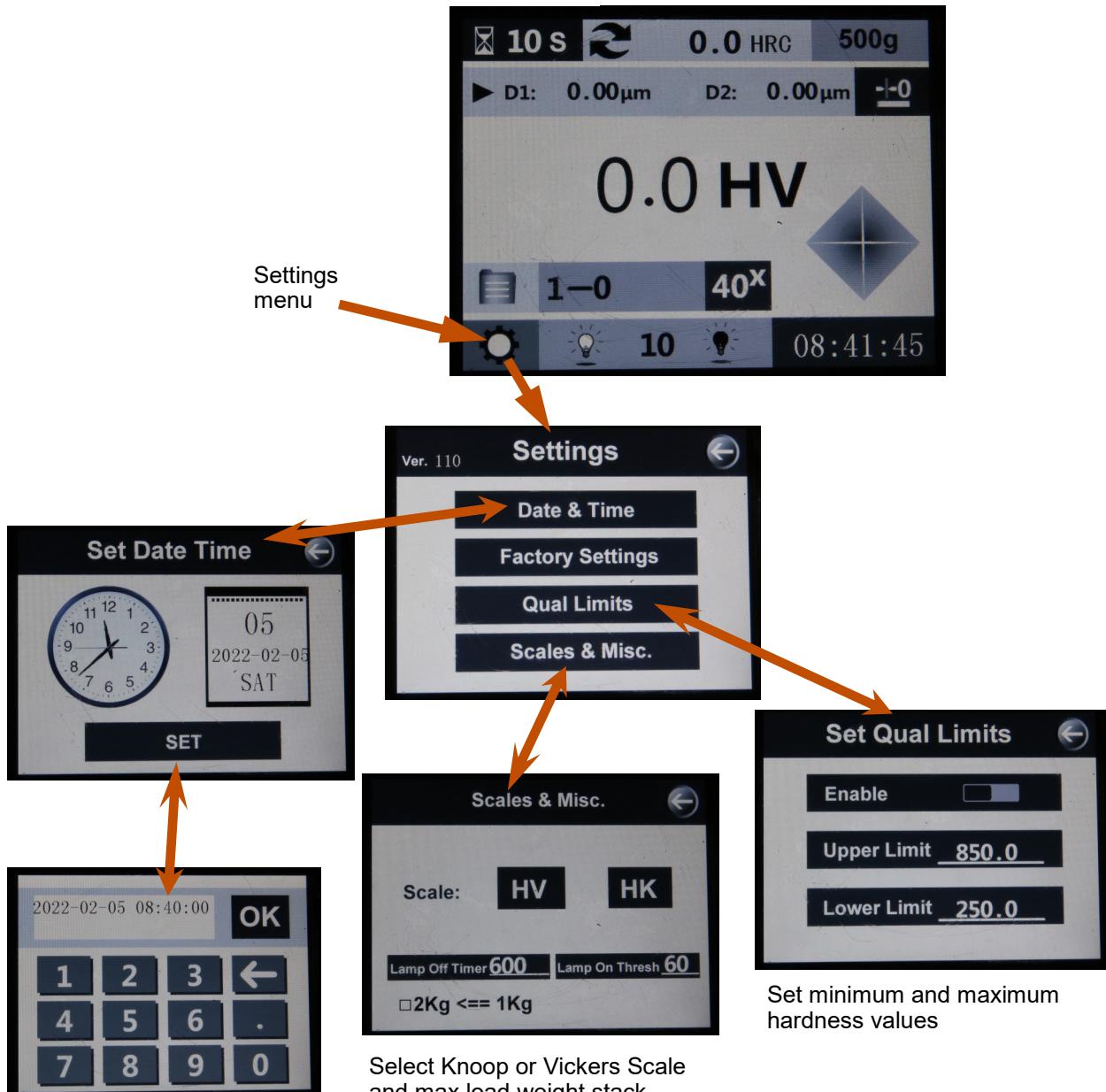


3601 E. 34th St. Tucson, AZ 85713 USA Tel. +1-520-882-6598 Fax +1-520-882-6599 email: pace@metallographic.com Web: http://www.metallographic.com

#### 4.1f Control Panel (Data Management)



#### 4.1g Control Panel (Settings)



Enter year, month, day and time



## **5.0 Maintenance**

### **5.1 Introduction**

The **ALPHA-MHT-2000Z2** 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.

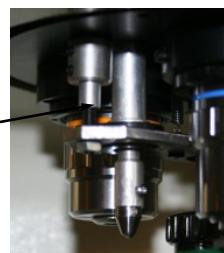
### **5.2 Cleaning outside cabinet**

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

## 6.0 Trouble Shooting

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





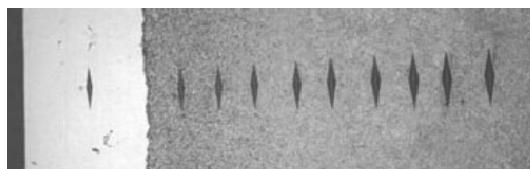
3601 E. 34th St. Tucson, AZ 85713 USA Tel. +1-520-882-6598 Fax +1-520-882-6599 email: pace@metallographic.com Web: http://www.metallographic.com

## 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.

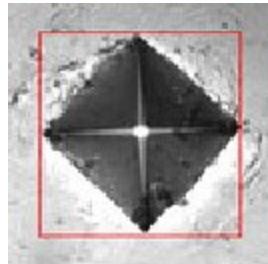
Microhardness is primarily determined with either a Knoop or Vickers indenter under test loads in the range of 1 to 2000 gram-force. Microhardness is used to measure the hardness of specific phases, small particles, and for brittle materials. Figure 6-1 shows the Knoop microhardness indents for a heat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

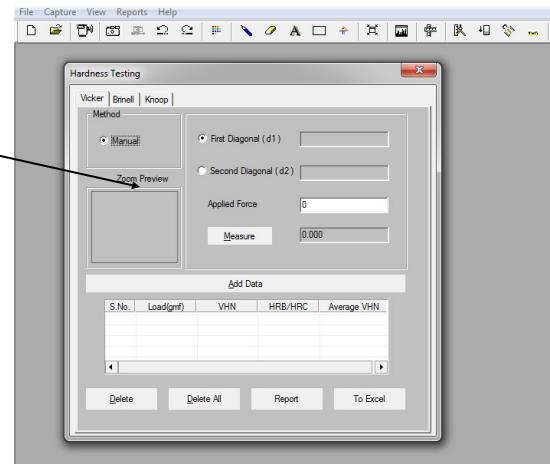
## 9.0 Appendix MHT measurement software (optional)

### 9.0.1 General Description

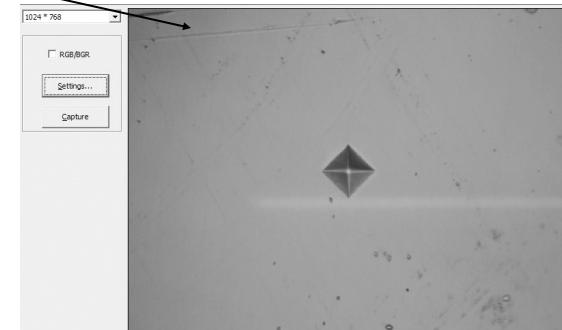
**Microhardness Pro 4.2** is an easy to use image analysis software for measuring microhardness and for generating easy to distribute Excel reports. It is a single screen Windows based system.

The **Microhardness Pro 4.2** software can handle both gray monochrome (8 bit) and color (24 bit) images. Multiple images of any size can be opened and displayed on the screen for analysis or comparison. The software supports the most common formats like BMP, JPEG, TIFF, PNG, GIF and PSD. Live images also can be observed and captured on the same platform. Since the system is in a Windows environment, graphs and charts displayed on the monitor can be quickly transferred into other Windows based programs such as, MS Word, MS Excel or any other commercial Windows based software for the purpose producing reports and presentations.

Main screen



Capture screen



Vickers Indent

