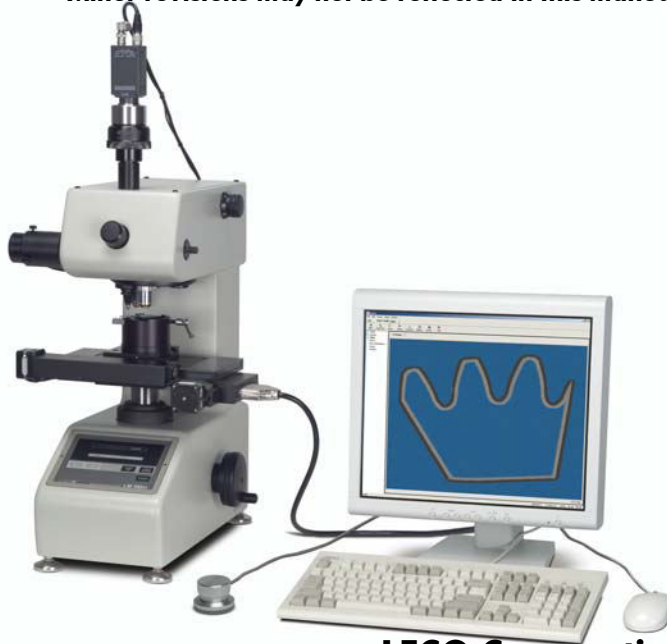# AMH43 Automatic Micro/Macro-indentation Hardness Testing System

INSTRUCTION MANUAL

Software Version 1.4x
Part Number 200-701
January 2005

LECO Corporation
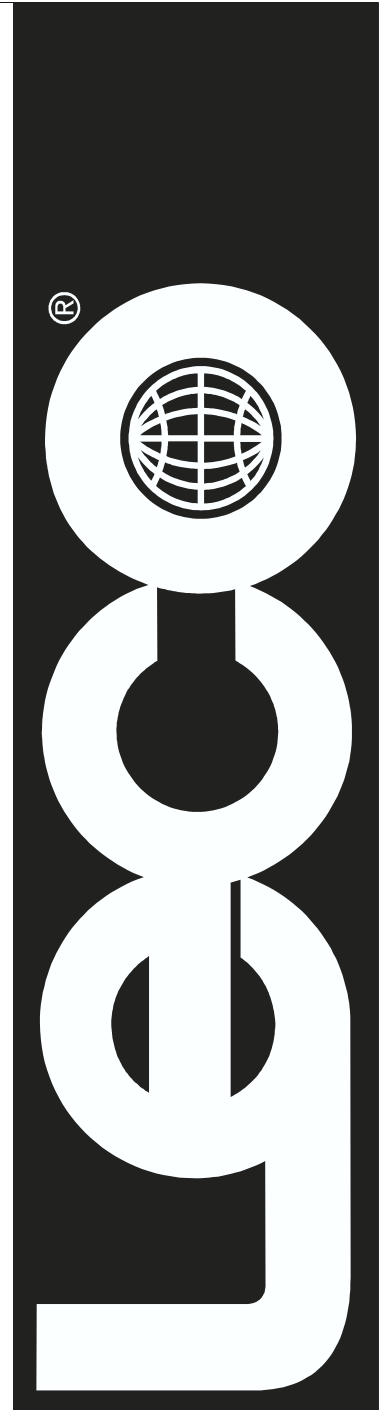
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1 Introduction

Illustrations

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Warranty

Equipment manufactured by LECO Corporation, St. Joseph, Michigan is warranted free from defect in material and workmanship for a period of six months from the date of installation. Equipment not manufactured by LECO is covered to the extent of warranty provided by the original manufacturer and this warranty does not cover any equipment, new or used, purchased from anyone other than LECO Corporation. All replacement parts shall be covered under warranty for a period of thirty days from date of purchase. **LECO makes no other representation or warranty of any other kind, expressed or implied, with respect to the goods sold hereunder, whether as to merchantability, fitness for purpose, or otherwise.**

Expendable items such as crucibles, combustion tubes, chemicals, and items of like nature are not covered by this warranty.

LECO's sole obligation under this warranty shall be to repair or replace any part or parts which, to our satisfaction, prove to be defective upon return prepaid to LECO Corporation, St. Joseph, Michigan. This obligation does not include labor to install replacement parts, nor does it cover any failure due to accident, abuse, neglect, or use in disregard of instructions furnished by LECO. In no event shall damages for defective goods exceed the purchase price of the goods, and **LECO shall not be liable for incidental or consequential damages whatsoever.**

All claims in regard to the parts or equipment must be made within ten (10) days after Purchaser learns of the facts upon which the claim is based. Authorization must be obtained from LECO prior to returning any other parts. This warranty is voided by failure to comply with these notice requirements.

Notice

The warranty on LECO equipment remains valid only when genuine LECO replacement parts are employed. Since LECO has no control over the quality or purity of consumable products not manufactured by LECO, the specifications for accuracy of results using LECO instruments are not guaranteed unless genuine LECO consumables are employed in conjunction with LECO instruments. If purchaser defaults in making payment for any parts or equipment, this warranty shall be void and shall not apply to such parts and equipment. No late payment or cure of default in payment shall extend the warranty period provided herein.

LECO Corporation is not responsible for damage to any associated instruments, equipment, or apparatus nor will LECO be held liable for loss of profit or other special damages resulting from abuse, neglect, or use in disregard of instructions. The Buyer, their employees, agents, and successors in interest assume all risks and liabilities for the operation, use, and/or misuse of the product(s) described herein and agree to indemnify, hold harmless, and defend the seller from any and all claims and actions arising from any cause whatsoever, including seller's negligence for personal injury incurred in connection with the use of said product(s) and any and all damages proximately resulting therefrom.

Caution

The instrument should be operated only by technically qualified individuals who have fully read and understand these instructions. The instrument should be operated only in accordance with these instructions.

The operator should follow all of the warnings and cautions set forth in the manual and the operator should follow and employ all applicable standard laboratory safety procedures.

Warning and Caution Symbols

The following symbols may be found on LECO equipment or their components. These symbols indicate the use of specific safety guidelines. Important safety information is highlighted in this manual by one of the following symbols as well as WARNING and CAUTION statements. Operator and service personnel must follow these instructions for personal safety and to prevent damage to the equipment.

WARNING **This symbol indicates a risk of electrical shock. Refer to the manual for specific instructions.**

WARNING **This symbol indicates a high temperature surface. Refer to the manual for specific instructions.**

CAUTION **This symbol indicates a caution. Refer to the manual for specific instructions.**

LECO equipment should be operated only by technically qualified individuals who have fully read and understand the instructions detailed in this manual. The equipment should be operated only in accordance with these instructions.

The operator should follow all of the warnings and cautions set forth in this manual and the operator should follow and employ all applicable standard laboratory safety procedures.

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Major Equipment List

Items listed below and repeated throughout this manual are subject to revision. Please consult the packing slip received with the instrument.

AMH43DAACM Microhardness Tester System includes:

1	200-701-101	Software Installation Guide
1	259-048	AMH43 Software Kit
1	686-345	AMH43 PC Tower Assembly
1	704-241	Copy Protection Key
1	710-172	19" Flat Screen Color Monitor
1	863-471	AMH43 Component Pack (for complete listing, see Component and Accessories List, page 1–16)
1	863-472	AMH43AT KV 10-KGF TE Assembly

AMH43DAACR Microhardness Tester System includes:

1	200-701-101	Software Installation Guide
1	259-048	AMH43 Software Kit
1	704-241	Copy Protection Key
1	863-471	AMH43 Component Pack (for complete listing, see Component and Accessories List, page 1–16)
1	863-472	AMH43AT KV 10-KGF Assembly
1	863-478	AMH43 Component Pack CR (for complete listing, see Component and Accessories List, page 1–16)

AMH43DSACM Microhardness Tester System includes:

1	200-701-101	Software Installation Guide
1	259-048	AMH43 Software Kit
1	686-345	AMH43 PC Tower Assembly
1	704-241	Copy Protection Key
1	710-172	19" Flat Screen Color Monitor
1	863-482	AMH43 Component Pack (for complete listing, see Component and Accessories List, page 1–16)
1	863-483	AMH43DSAT KV 10-1KGF Assembly

AMH43DSACR Microhardness Tester System includes:

1   200-701-101   Software Installation Guide

1   259-048   AMH43 Software Kit

1   704-241   Copy Protection Key

1   863-478   AMH43 CR Component Pack (for complete listing, see Component and Accessories List, page 1–16)

1   863-482   AMH43 Component Pack (for complete listing, see Component and Accessories List, page 1–16)

1   863-483   AMH43DSAT KV 10-1KGF Assembly

AMH433AKACM Microhardness Tester System includes:

1   200-701-101   Software Installation Guide

1   259-048   AMH43 Software Kit

1   686-345   AMH43 PC Tower Assembly

1   704-241   Copy Protection Key

1   710-172   19" Flat Screen Color Monitor

1   863-471   AMH43 Component Pack (for complete listing, see Component and Accessories List, page 1–16)

1   863-559   AMH43AT K 10-1KGF Assembly

AMH433AKACR Microhardness Tester System includes:

1   200-701-101   Software Installation Guide

1   259-048   AMH43 Software Kit

1   704-241   Copy Protection Key

1   863-471   AMH43 Component Pack

1   863-478   AMH43 Pack Component CR (for complete listing, see Component and Accessories List, page 1–16)

1   863-559   AMH43AT K 10-1KGF Assembly

AMH433AVACM Microhardness Tester System includes:

1   200-701-101   Software Installation Guide

1   259-048   AMH43 Software Kit

1   686-345   AMH43 PC Tower Assembly

1   704-241   Copy Protection Key

1   710-172   19" Flat Screen Color Monitor

1   863-471   AMH43 Component Pack (for complete listing, see Component and Accessories List, page 1–16)

1   863-560   AMH43AT V Digital 10-1KGF Assembly

AMH433AVACR Microhardness Tester System includes:

1   200-701-101   Software Installation Guide

1   259-048   AMH43 Software Kit

1   704-241   Copy Protection Key

1   863-471   AMH43 Component Pack (for complete listing, see Component and Accessories List, page 1−16)

1   863-478   AMH43 Component Pack CR (for complete listing, see Component and Accessories List, page 1−16)

1   863-560   AMH43AT V Digital 10-1KGF Assembly

AMH433SKACM Microhardness Tester System includes:

1   200-701-101   Software Installation Guide

1   259-048   AMH43 Software Kit

1   686-345   AMH43 PC Tower Assembly

1   704-241   Copy Protection Key

1   710-182   19" Flat Screen Color Monitor

1   863-482   AMH43SAT Component Pack (for complete listing, see Component and Accessories List, page 1−16)

1   863-561   AMH433SAT K 10-1KGF Assembly

AMH433SKACR Microhardness Tester System includes:

1   200-701-101   Software Installation Guide

1   259-048   AMH43 Software Kit

1   704-241   Copy Protection Key

1   863-478   AMH43 Component Pack CR (for complete listing, see Component and Accessories List, page 1−16)

1   863-482   AMH43SAT Component Pack (for complete listing, see Component and Accessories List, page 1−16)

1   863-561   AMH433SAT K 10-1KGF Assembly

AMH433SVACM Microhardness Tester System includes:

1   200-701-101   Software Installation Guide

1   259-048   AMH43 Software Kit

1   686-345   AMH43 PC Tower Assembly

1   704-241   Copy Protection Key

1   710-172   19" Flat Screen Color Monitor

1   863-482   AMH43SAT Component Pack (for complete listing, see Component and Accessories List, page 1−16)

1   863-562   AMH43SAT V Digital 10-1KGF Assembly

AMH433SVACR Microhardness Tester System includes:

1	200-701-101	Software Installation Guide
1	259-048	AMH43 Software Kit
1	704-241	Copy Protection Key
1	863-478	AMH43 Component Pack CR (for complete listing, see Component and Accessories List, page 1–16)
1	863-482	AMH43SAT Component Pack (for complete listing, see Component and Accessories List, page 1–16)
1	863-562	AMH43SAT V Digital 10-1KGF Assembly

Options

To place an order by phone, please call our customer service department toll-free in the United States at 1-800-292-6141 or 269-985-5496. Orders may also be sent by fax to 269-982-8977.

863-472-0OP		**AMH43 Options**
1	259-048-CPK	AMH43 Software Kit With Copy Protection Key
1	259-048UPGR	AMH43 Software Kit Upgrade Without Copy Protection Key
1	619-995	USB Bar Code Reader CCD
1	723-036	Add On 15" Monitor PC Kit
1	863-579	Upgrade To AMH43 Kit

Components and Accessories List

863-471 AMH43 Component Pack includes:

1	614-621	9M/F Filter Adapter
1	780-898	AC Line Cord
1	808-827	TV Adapter Coupling
1	860-256	Stage Micrometer
1	860-959-103	Coax Cable
1	860-961-103	High Resolution Camera
1	861-314	100/250 Power Supply Assembly
1	861-604	1.0X Video Micros Coupler
1	863-418	3 AXIS Controller Stage
1	863-419	Modem Cable With Adapter
1	863-428	9D F-RS/25D Cable Assembly
1	863-437	Focus Motor Cable Assembly
1	863-454	XY STAGE/CNT W Cable Assembly
1	863-469	Sample Leveling Assembly
1	863-470	Mounting Sample Holder Plate Assembly
1	863-479	USB Audio & IN Controller
1	863-491	Sample Holder Assembly
1	865-340-122	Camera Video L Cable Assembly
1	865-340-207	COAX BNC Connector E Adaptor

863-472 AH43AT K 10-KGF Tester Assembly includes:

1	700-749	222 Sealant Adhesive
1	769-459	242 Sealant Adhesive
1	774-664	Locktite Adhesive
1	782-369	Screwlock Kit 4-40 M-F
1	863-213-247	Dual Indenter Tester
1	863-404	AMH43 Back Plate
1	863-406	Cable HT/Stepper Motor Assembly
1	863-407	Focus Motor Assembly
1	863-408	Gear Driver Adapter
1	863-409	Stage Adapter X-Y
1	863-410	Stage Adapter Plate X-Y
1	863-416	Timing Belt
1	863-417	Special Stage 4 X 3
1	863-429	Base Cover Assembly
1	863-426	Motor Cover
1	863-427	Base Plate Tester
1	863-432	Reworked Drive Pulley
1	863-498	Timing Pulley

863-478 AMH43 Component Pack includes:

1	200-701	AMH43 Instruction Manual
1	611-119	Receptacle Strip
1	618-980	Mouse Pad
1	723-012	Video Dual Monitor Card
1	777-945	Frame Grabber Card

863-482 AMH43SAT Component Pack includes:

1	614-621	9 M/F Filter Adapter
1	780-898	AC Line Cord
1	808-827	Coupling Adapter
1	860-256	Stage Micrometer
1	809-959-103	Coax Cable Assembly
1	860-961-103	High Resolution Monochromatic Camera
1	861-314	Power Supply Assembly
1	863-418	3-Axis Stage Controller
1	863-419	Modem Cable
1	863-428	9D F-RS/25D Cable Assembly
1	863-454	XY Stage/CNT Cable Assembly
1	863-469	Leveling Assembly
1	863-470	Sample Holder Mounting Plate
1	863-491	Sample Holder
1	865-340-207	BNC Coax Adapter

863-559 AH43AT K 10-1KGF Tester Assembly includes:

1	700-749	222 Sealant Adhesive
1	769-459	242 Sealant Adhesive
1	774-664	Locktite Adhesive
1	782-369	Screwlock Kit 4-40 M-F
1	863-404	AMH43 Back Plate
1	863-406	Cable HT/Stepper Motor Assembly
1	863-408	Gear Driver Adapter
1	863-409	Stage Adapter X-Y
1	863-410	Stage Adapter Plate X-Y
1	863-416	Timing Belt
1	863-417	Special Stage 4 X 3
1	863-429	Base Cover Assembly
1	863-426	Motor Cover
1	863-427	Base Plate Tester
1	863-432	Reworked Drive Pulley
1	863-498	Timing Pulley
1	863-559-010	LM100A Digital Tester
1	863-568	Focus Motor Driver Assembly

863-560 AH43AT V 10-1KGF Tester Assembly includes:

1	700-749	222 Sealant Adhesive
1	769-459	242 Sealant Adhesive
1	774-664	Locktite Adhesive
1	782-369	Screwlock Kit 4-40 M-F
1	863-404	AMH43 Back Plate
1	863-406	Cable HT/Stepper Motor Assembly
1	863-408	Gear Driver Adapter
1	863-409	Stage Adapter X-Y
1	863-410	Stage Adapter Plate X-Y
1	863-416	Timing Belt
1	863-417	Special Stage 4 X 3
1	863-429	Base Cover Assembly
1	863-426	Motor Cover
1	863-427	Base Plate Tester
1	863-432	Reworked Drive Pulley
1	863-498	Timing Pulley
1	863-560-010	LM100A Digital Tester
1	863-568	Focus Motor Driver Assembly

863-561 AH433SAT K Digital 10-1 Tester Assembly includes:

1	863-409	Stage Adapter X-Y
1	863-410	Stage Adapter Plate X-Y
1	863-458	Auto Stage 75MMX50MM
1	863-559-010	LM100A Digital K Tester

863-562 AH433SAT V Digital 10-1 Tester Assembly includes:

1	863-409	Stage Adapter X-Y
1	863-410	Stage Adapter Plate X-Y
1	863-458	Auto Stage 75MMX50MM
1	863-560-010	LM100A Digital V Tester

Specifications

Hardness Mechanism

Type .... Future Tech Hardness Tester with 10, 25, 50, 100, 300, 500, and 1000 gram load capability

Objectives................................. 10X and 50X Objectives

Camera Coupler.......................... Magnifications 3.0X to 0.7X

Stage Controller.......................... 1 μm Resolution Stepper

Stage Movement Range .... 50 mm X 50 mm

Sample Height Capabilities .... 60 mm Maximum Specimen Height

Autofocus .... Stepper Controlled

Dimensions .... 186 mm (Width) X 435 mm (Depth) X 499 mm (Height)

Weight .... 36 kg (including standard accessories)

Computer

CPU Type.................................. Intel® Pentium® IV Processor (min.)   256K External Cache
512 MB RAM (min.)
64 Bit Accelerated PCI Video
32MB Video RAM (min.)
40 GB Hard Drive (min.)
CD-RW Drive
2 Serial Ports & 1 Parallel Port
USB Port
Integrated Network adapter

Monitor..................................... 18" LCD
(Multi-sync)

Operating System .... Microsoft® Windows® 2000

Overall

Power Requirements.................... 120 V~ 50/60 Hz

Accuracy................................... 1% Relative

Precision................................... 1% Relative Standard Deviation or Better

Software

Windows Compatible .... Windows® 2000 / XP

Sample..................................... Supports Multi-Sample Analysis with Multiple
Traverse Patterns for Each Sample

Reporting................................. Multi-Sample Reporting with Charts, Statistics,
Line Charts, Bitmaps, Bar Charts, Data tables,
Histograms, and Text

SPC .... Statistical Charting with Control Limits

Case Depth .... Case Depth Calculation and Plotting

Calibration .... Linear Single Sample Calibration

Export .... CSV File and Windows Clipboard Export Support

Indenter .... Interchangeable (Supports Vickers or Knoop)

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2 Installation

Illustrations

Hardware Installation

Always be sure all system power is OFF before connecting any cables.

1.   Carefully unpack components and place the hardness tester, computer tower, monitor, (optional printer,) and joystick on a suitable work surface as shown in Figure 2-1 Component Placement. Do **not** tilt the hardness tester more than 30°.
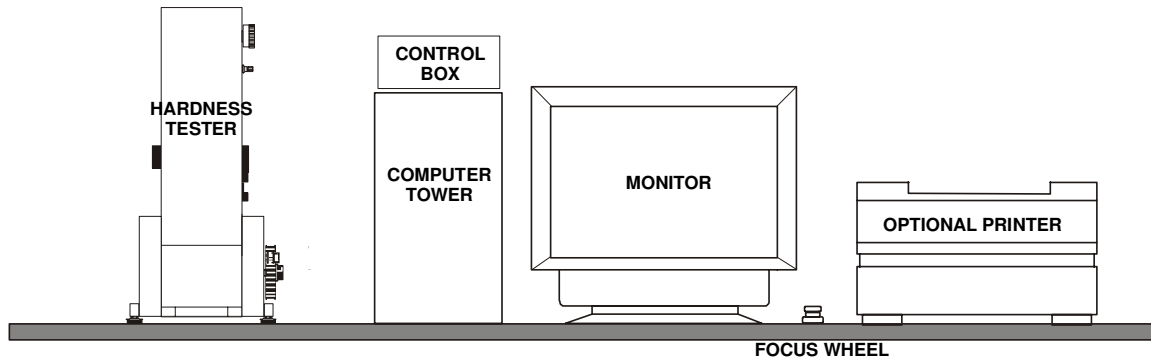
Figure 2-1
Component Placement

2.   Install the leveling feet into the base of the hardness tester.

3.   Use the leveling feet in conjunction with the leveling vial to level the unit. Adjust the leveling feet until the air bubble in the leveling vial is centered.

4.   Refer to Figure 2-2 AMH43 System Connections, page 2–5 and connect the monitor to the computer tower using the cable provided with the monitor.

5.   Place the keyboard in the desired location and then refer to Figure 2-2 AMH43 System Connections, page 2–5 and connect the keyboard cable to the back of the computer tower.

6.   Place the mouse in the desired location and then refer to Figure 2-2 AMH43 System Connections, page 2–5 and connect the mouse cable to the back of the computer tower.

7.   If installing an optional printer, refer to Figure 2-2 AMH43 System Connections, page 2–5 and connect one end of the printer interface cable (provided with the printer) to the back of the computer tower. Connect the other end of the printer interface cable to the printer.

8. Refer Figure 2-2 AMH43 System Connections, page 2–5 and connect the 863-428 Cable Assembly between the back of the computer tower and the RS232C port on the back of the hardness tester.

9. Refer to Figure 2-2 AMH43 System Connections, page 2–5 and connect the 863-419 Modem Cable with Adapter between the back of the computer tower and the RS232-1 port on the back of the control box.

10. Connect the Focus Wheel to a USB port on back of the computer as shown in Figure 2-2 AMH43 System Connections, page 2–5.

11. Refer to Figure 2-2 AMH43 System Connections, page 2–5 and connect the 863-437 Motor Focus Cable Assembly between the Z port on the back of the control box and the back of the hardness tester.

12. Remove the hardness tester's top (head) cover.

13. Carefully remove the foam shipping pad from inside the top of the hardness tester. Save this foam shipping pad for reuse whenever moving the hardness tester.

14. Install the weights in the hardness tester following the instructions described in the manual for the hardness tester.

15. Turn the load control dial to make sure the weight container moves vertically.

16. Reinstall the top (head) cover.

17. Remove the indenter retaining ring by unscrewing it, install the spindle ring (found in the accessory box), and then reinstall the indenter retaining ring.

18. Remove the protective plastic from the optics port and install the measuring eyepiece. Be sure to connect the cord (from the measuring eyepiece) to the ENCODER port on the back of the hardness tester.

19. Position the stage on the large shaft found below the turret of the hardness tester and then tighten the screw to the shaft.

20. Attach the stage control cable from the stage to the X Y port on the back of the control box.

21. Once the hardness tester has been assembled, connect the camera adapter to the coupler located on the top cover.

22. If the camera adapter needs to be turned, rotate it on its base. The camera adapter is factory set to be par focal. If the top portion of the adapter is turned, the component will no longer be par focal.

PRINTER

TO FACILITY
POWER

FOCUS WHEEL
863-479
USB
CONTROLLER

861-314
POWER SUPPLY

865-340-122
CAMERA CABLE

TO FACILITY
POWER

860-961-103
CAMERA

863-428
CABLE

TO FACILITY
POWER

TO FACILITY
POWER

TO FACILITY
POWER

863-419
MODEM CABLE
WITH ADAPTER

863-437
MOTOR FOCUS
CABLE ASSEMBLY

863-454
CABLE
CONTROLLER TO STAGE

RS232-2   SH.A   SH.B   SH.C   FILTER 2   FILTER 1

RS232-1   POWER   JOYSTICK   Z   X Y

TO FACILITY
POWER

863-418
CONTROLLER

**Figure 2-2
AMH43 System Connections**

23. Install the video camera module onto the camera adapter.

24. Connect the video camera cable assembly between the video camera and the computer tower as shown in Figure 2-2 AMH43 System Connections, page 2–5.

25. The camera has DIP switches set at the factory. These settings do not need to be changed. Refer to the manufacturer's literature for default settings.

26. Make sure the hardness tester Power ON/OFF switch is in the OFF position.

27. Connect the hardness tester's power cable to the back of the hardness tester and then to facility power.

28. Make sure the monitor's Power ON/OFF switch is in the OFF position.

29. Connect the monitor's power cable to the back of the monitor and then to facility power.

30. Make sure the optional printer's Power ON/OFF switch is in the OFF position.

31. Connect the optional printer's power cable to the back of the optional printer and then to facility power.

32. Make sure the control box's Power ON/OFF switch is in the OFF position.

33. Connect the control box's power cable to the back of the control box and then to the power supply box.

34. Connect the control box's power supply cable to facility power.

35. Make sure the computer tower's Power ON/OFF switch is in the OFF position.

36. Connect the computer tower's power cable to the back of the computer tower and then to facility power.

37. Turn the components ON in the following order:

   A. Hardness Tester.

   B. Optional Printer.

   C. Monitor.

   D. Computer Tower.

38. Wait 5 seconds and then power ON the Control Box.

39. The system is preloaded with all the necessary files and the AMH43 program. To run the AMH43 software, double click the AMH43 icon on the monitor. If for some reason the AMH43 icon is not on the desktop display, proceed as follows:

   A. Click the START button.

   B. Select Programs.

   C. Select LECO AMH43.

   D. Click on AMH43.

40. For maximum protection from dust, the hardness tester should be covered with the provided cover when not in use.

Software Installation

Typically, LECO has installed the AMH43 software. The CD is provided as a precautionary measure. To reinstall the AMH43 Software, use the following procedure.

NOTE ➤ The following procedure only needs done if the AMH43 software has not been installed or needs reinstalled. For updating to a new software version, refer to Install AMH43 software, page .

Prepare the Computer

Connect Hardware

To install the software the computer should only be connected to those devices required to boot and login (keyboard, mouse, monitor, power). Disconnect all other devices.

Windows Update for Windows 2000

This procedure only applies to a Windows 2000 computer. Refer to Install AMH43 Software, page if using Windows XP.

1. Turn on the computer and log in to the Administrator account.

2. If any "new hardware detected" dialogs open at startup, select cancel.

3. Open the Control Panel System dialog box:

    A. Open the Start Menu at bottom left corner of the screen.

    B. Select Settings.

    C. Select Control Panel.

    D. Double-Click System.

4. Check the service pack version of Windows. Look for a section of text similar to this:
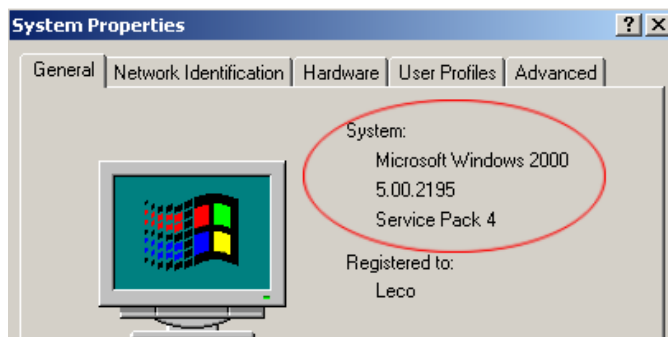
5. If Service Pack has a value of 3 or greater, select Cancel and skip to Install AMH43 Software, page .

6. If Service Pack has a value of less than 3:

    A. Insert the CD titled Win2K SP4.

    B. Double-Click My Computer.

    C. Double-Click CD Icon.

    D. Double-Click W2KSP4_EN (For Non-English, _EN part will be different).

    E. Select Next.

    F. Select I Agree.

    G. Select Next.

    H. Select Do Not Archive Files.

    I. Select Next.

    J. Select Finish.

    K. Wait for computer to restart.

    L. Login as Administrator.

Install AMH43 Software

1. Turn on the computer and login as Administrator (if not already logged in).

2. Insert CD Labeled AMH43 Version X.XX into CDROM Drive. Wait for AMH43 Setup Screen to appear.

3. Select AMH43 to install the AMH43 software.

    A. Select Yes.

    B. Select OK.

4. Select Meteor II to install the frame grabber drivers.

    A. Select Yes and wait for completion.

NOTE ➤ The Powermate and Rainbow drivers are installed by LECO and do not need reinstalled.

5. Select Exit.

6. Select OK.

7. After restarting, login as Administrator.

Setup Hardware

1. Ensure that all cables between the stage controller box and indenter are properly connected. Refer to Hardware Installation, page 2–3.

2. Connect the stage controller box to the first RS232 port of the computer and turn it on.

3. Connect the indenter to the second RS232 port of the computer and turn it on. If using LM300 – Perform LM 300 Setup at this time, page 3–11.

4. Connect the Powermate Focus Wheel to a USB port on the computer.

5. Wait for Windows to detect the Powermate Focus Wheel. This should take only a few seconds.

6. Restart the computer and login as Administrator.

7. Set the display settings to a screen resolution of 1280 x 1024, True Color (32 bit) and a monitor refresh rate of at least 72 Hz (refer to Windows Help).

Start the AMH43 Software

After all the components have been installed and connected, use the following procedure to start the AMH43 Software.

1. Double-click the AMH43 icon located on your Window's desktop.

2. A Software License Key Not Found or License Not Valid dialog box might appear if the key is not installed or if the key is initialized for use but not registered. Refer to Copy Protection Key, page 2−14 for more information.
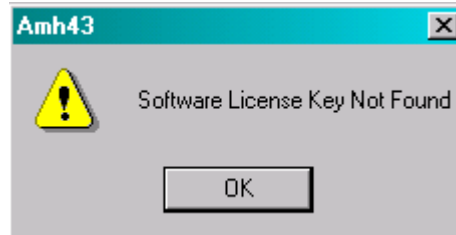
3. If a Login screen is displayed and a system password has **not** been assigned, click OK. To assign a password, refer to System Security, page 3−28. Once a password is assigned it must be entered before access to the AMH43 is allowed.
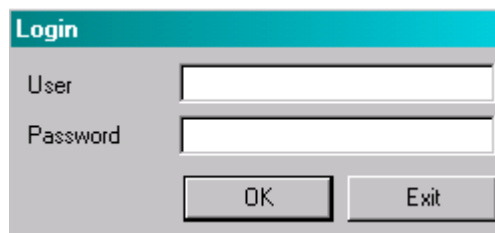
4. The AMH43 software starts. During the initial startup, a series of dialog boxes are automatically displayed to setup the system. Refer to Setup Camera, page 3–3, Setup Calibration Application, page 3–4, and Setup Hardness Testing Application, page 3–7 for more information.
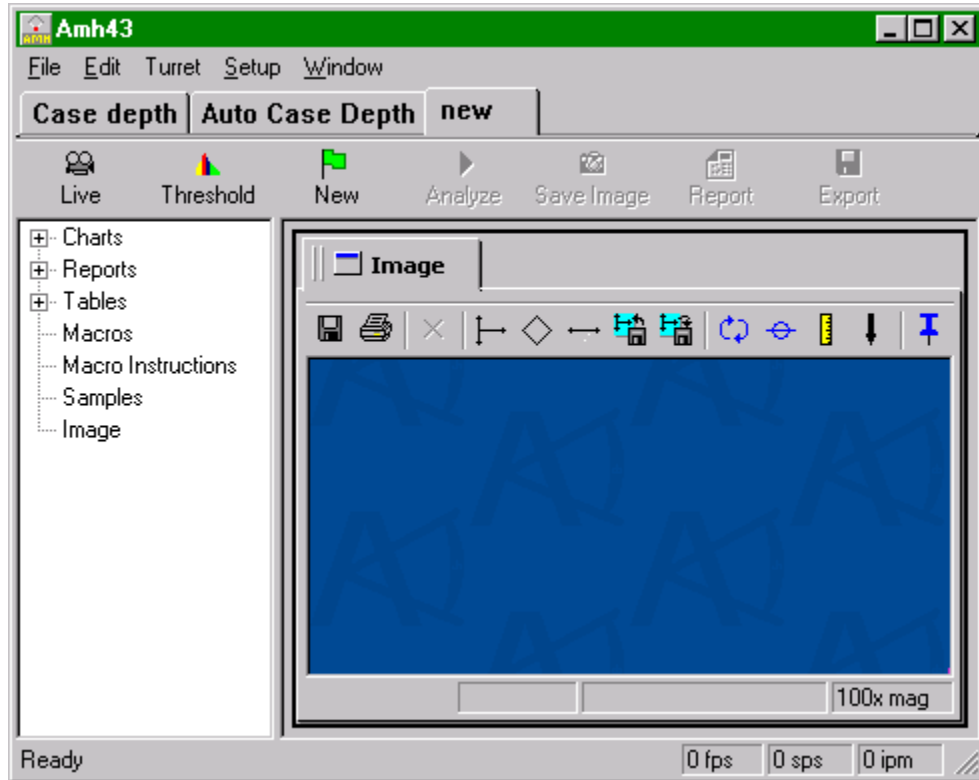
Copy Protection Key

A copy protection key is required to use the software. The key should remain installed in one of the USB ports while using the software.

1. A Software License Key Not Found or License Not Valid dialog box might appear if the key is not installed or if the key is initialized for use but not registered.

2. Click OK. Refer to Copy Protection Key Not Installed, page 2−15, or Copy Protection Key Not Registered, page 2−16.

Copy Protection Key Not Installed

The following dialog box appears if the copy protection key is not installed.
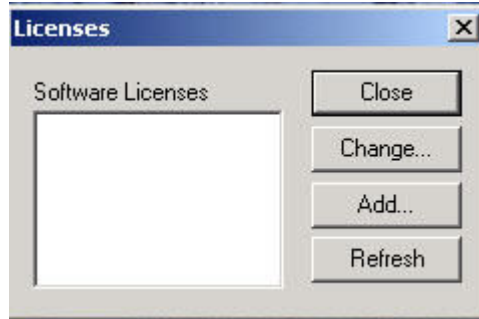
1.   Click Add. The following dialog box appears.
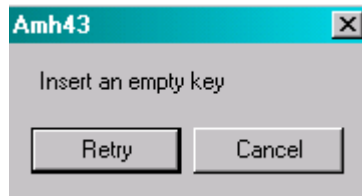
2.   Insert the copy protection key into the USB port at the back of the computer.

3.   Click Cancel. The Licenses dialog box appears.

4.   Click Close. The Login screen appears.

If the copy protection key is installed when the Software License Key Not Found or License Not Valid error message first appears on the screen, the following dialog box appears.

1.   Select the key number.

2.   Click Refresh.

3.   Click Close.

Copy Protection Key Not Registered

If the copy protection key is initialized but not registered, the following dialog box appears.
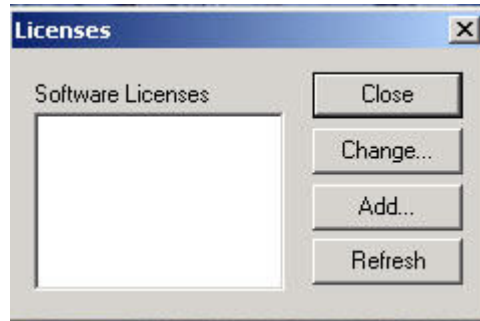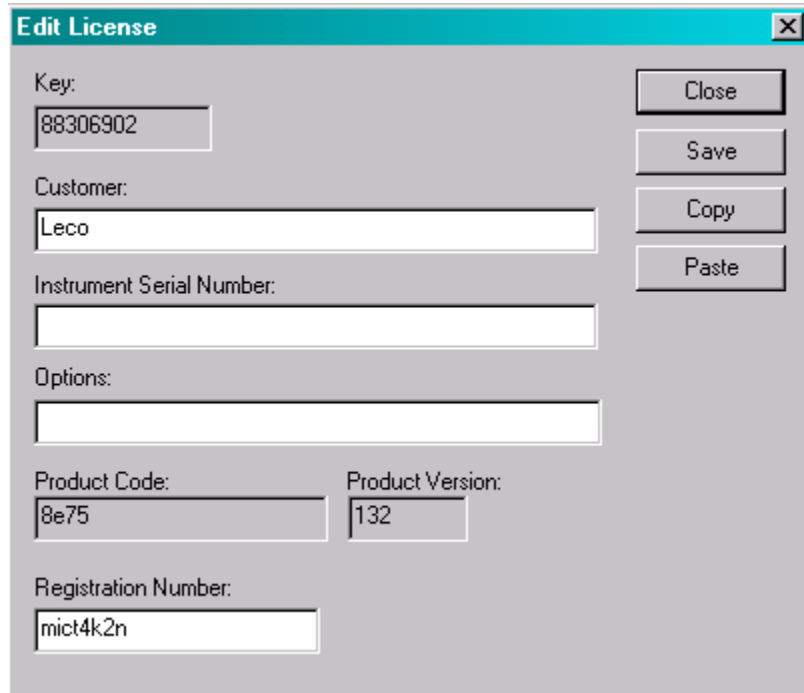
1. Click Add. The Edit License dialog box appears.

2. Complete the Edit License dialog box. Refer to Register the Software, page 2–17.

Register the Software

The AMH43 software must be registered at first use in order to use the software.

1. Install the copy protection key into a USB port on the back of the computer.

2. Open the AMH43 software. The following dialog box appears.

1. Type or paste new registration number under Registration Number.

   If the upgrade information is received in an email from LECO, the information can be copied from the email message and pasted into the Edit License dialog box.

2. Click Save.

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3 System Setup

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Setup Camera

The Camera dialog box is displayed during the initial startup and is used to setup the camera. It can also be opened from the Setup menu by selecting Hardware, Video and then, clicking the Properties button. The following procedure describes how to setup a hardness testing application.
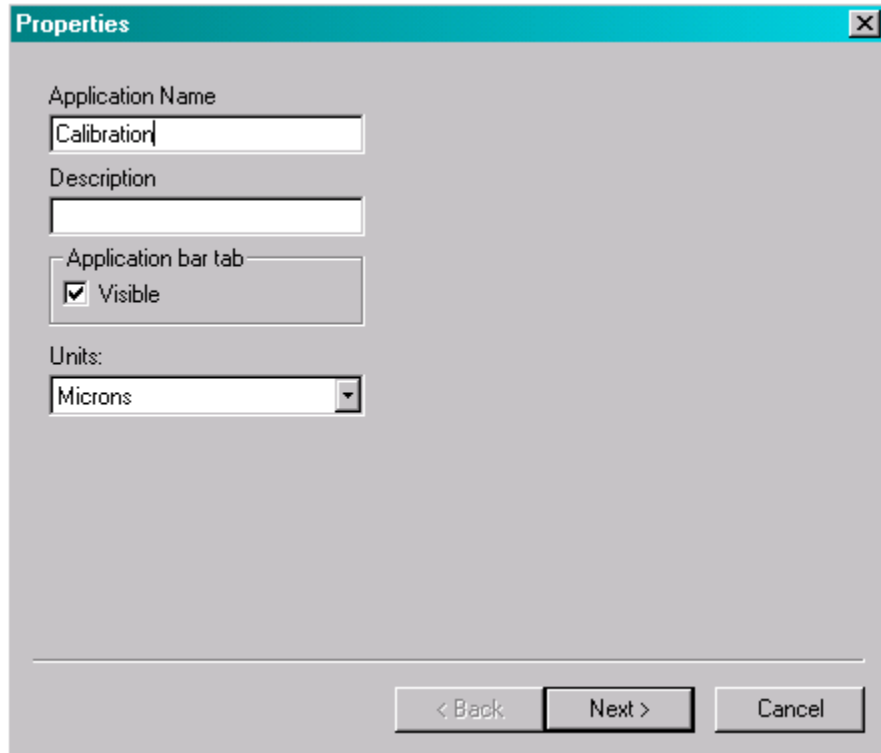
1. Enter the Camera Settings as shown below.
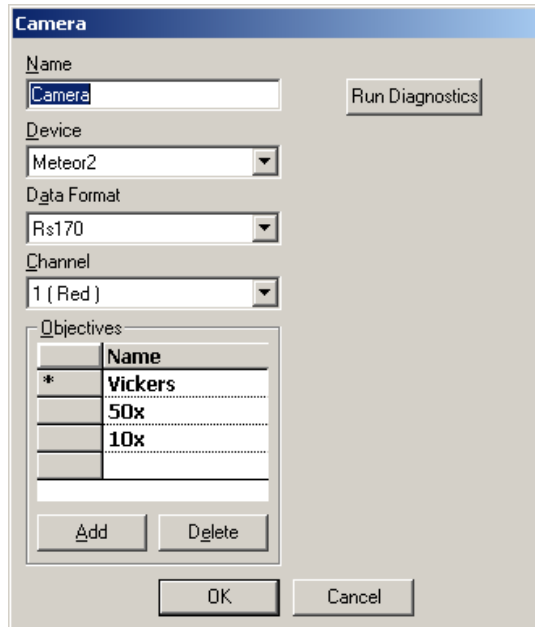
2. Enter the Name: Camera

3. Select the Device: Meteor2

4. Select the Data Format: Rs170

5. Select the Channel: 1 (Red)

6. Click the Add button to add the Indenter Type (Knoop, Vickers, or Both) and Objectives:

    Knoop

    Vickers

    50x

    10x

7. Select OK.

Setup Calibration Application

The Properties dialog box is displayed during the initial startup and is used to setup an application. It can also be opened by selecting Customize, Applications from the Setup menu. The following procedure describes how to create an application for calibration.

1. Click in the Application Name text box, and then enter the Application Name: Calibration.

2. Click Next. The Application dialog box is displayed.
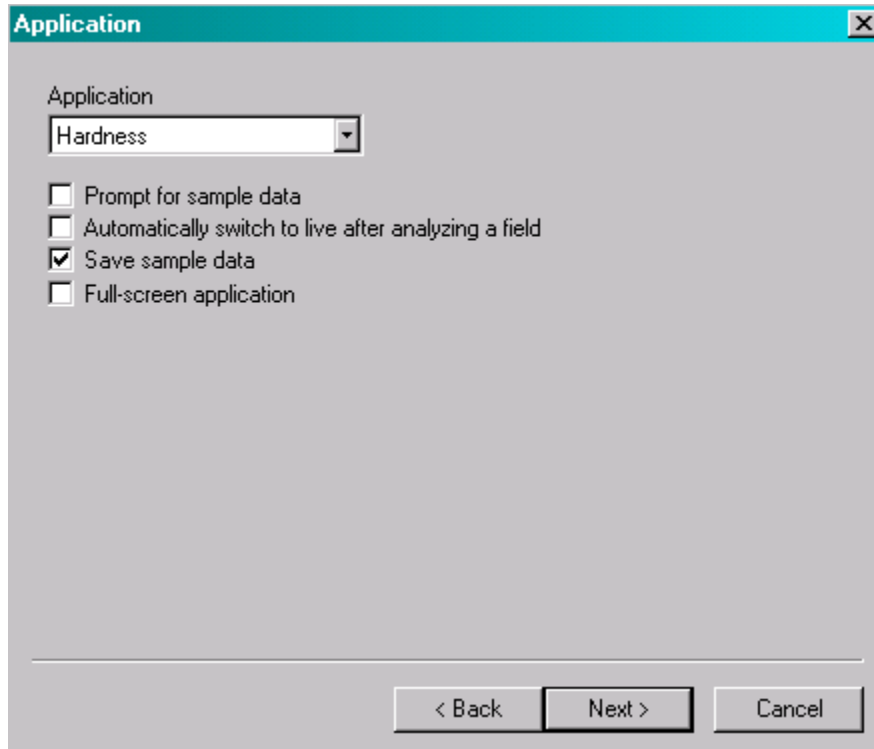
3. Click Hardness to select it from dropdown list.

4. Click Save Sample Data to select it.

5. Click Next. The Hardness dialog box is displayed.
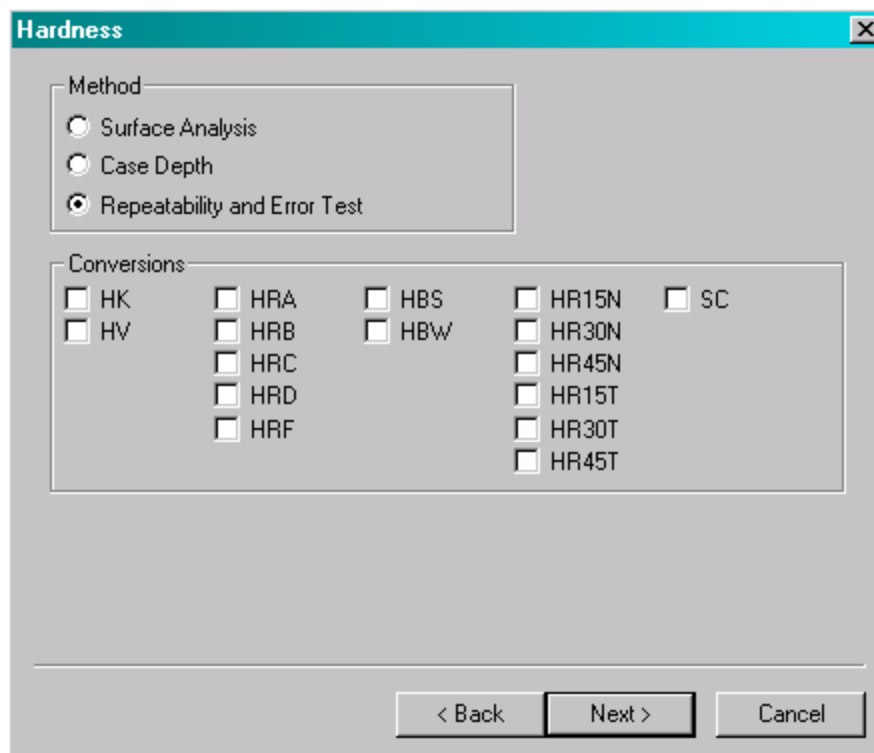
6. Click Repeatability And Error Test to select it.
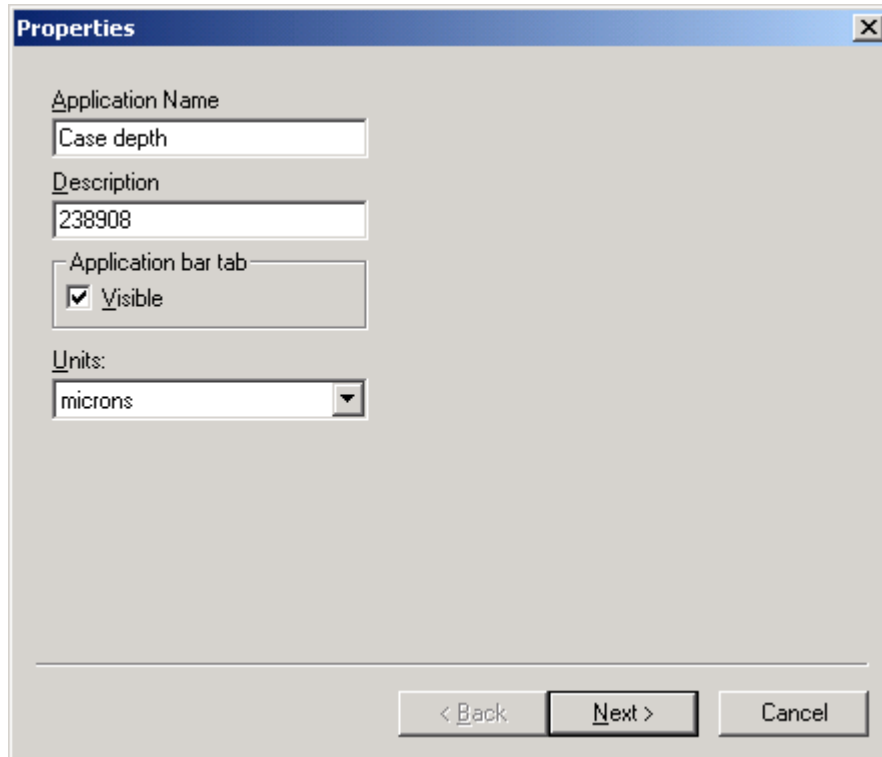
7. Click Next. The Report dialog box is displayed.
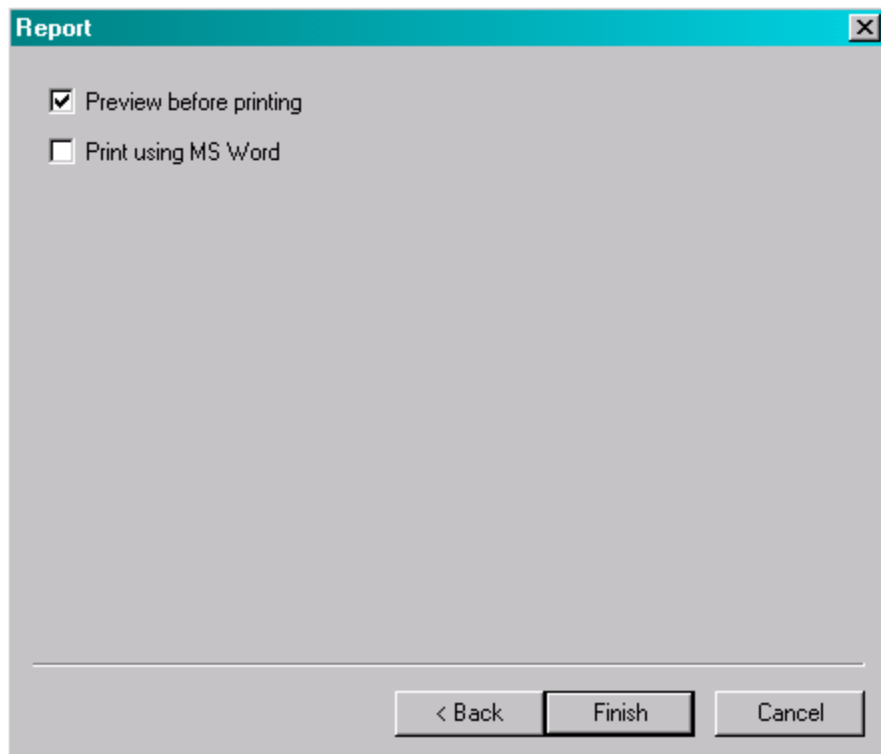
8. Click Finish.

Setup Hardness Testing Application

The Properties dialog box is displayed during the initial startup and is used to setup an application. It can also be opened by selecting Customize, Applications from the Setup menu. The following procedure describes how to setup a hardness testing application.

1. Click in the Application Name text box, and then enter a name to identify your application. You must enter a name. The name is displayed on the Application Bar and in the Applications dialog box. A well-chosen name helps identify each application.

2. Click in the Description text box, and then enter a description, such as the part number or material type to be analyzed with this application. The description is displayed in the Applications dialog box. When multiple applications are developed, a well-chosen name and detailed description help clarify how each application is used.

3. Click Visible to check or clear the checkbox. If this option is checked, the Application Tab is displayed in the Application Bar. The Application tab allows you to quickly switch between applications. If you prefer not to have the Application Tab displayed, click Visible to deselect it. You may wish to hide the Application tab for an application that is not fully developed.

4. Click Next. The Application dialog box is displayed.
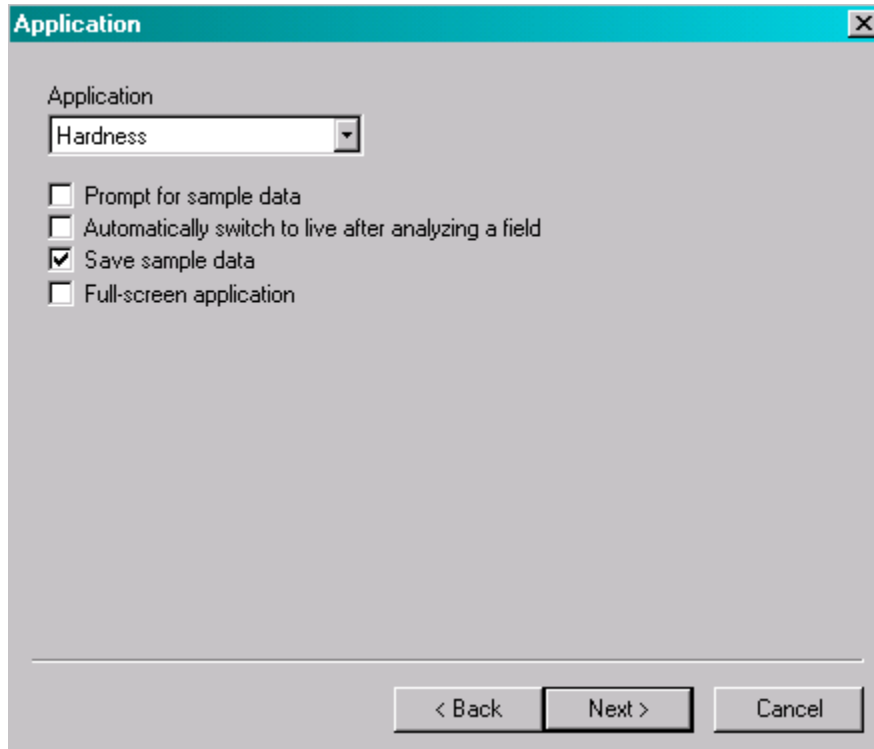
5. Click the Application dropdown list, and then click the appropriate application to select it.

6. Click the checkbox for the following options to check or uncheck them. A checkmark indicates the option is selected.

    Prompt for Sample Data displays the Enter Sample Data dialog box each time a new sample analysis is run. The dialog box prompts the technician to enter pertinent information about the sample, such as Name, Comments, Description, and Operator. This information is printed in the report. If samples are saved, then the information is also recorded in the Sample Set spreadsheet. If this option is not selected, the technician will need to enter the sample information directly into the Sample Set spreadsheet.

    Automatically Switch to Live After Analyzing a Field displays the live image after analyzing a field. This accelerates the analysis. However, the image that shows the items, which are analyzed, is not displayed. If Return to Live is not selected, the technician must click the Live button to view the live image after analyzing a field.

    Save Sample Data stores the sample analysis results. When the Save Sample Data option is selected, the results for each sample analyzed are saved in a new row of the Sample Set spreadsheet. If Save Samples is not selected, sample data is replaced when a new sample is run or the program is closed.

Full-screen Application activates the full-screen view. Full-screen view enlarges the sample image and simplifies the user-interface. If Full-screen Application is selected, the numerical results are not displayed until the report is printed.

7. Click Next. The Hardness dialog box is displayed.
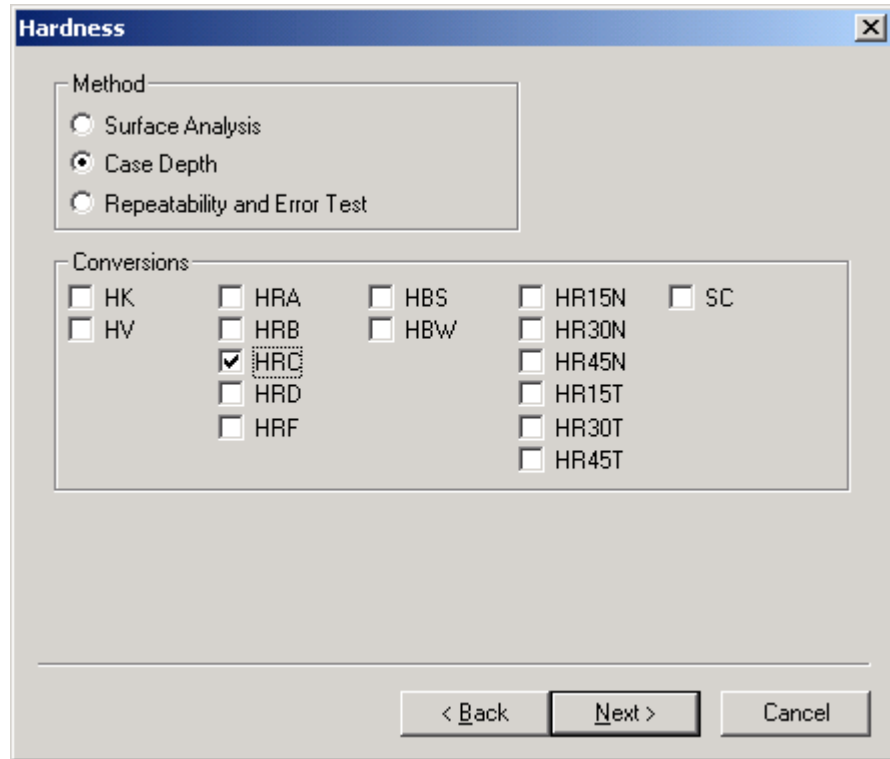
8. Click the Method to select it.

9. Click the Conversion to select it.

10. Click Next. The Report dialog box is displayed.
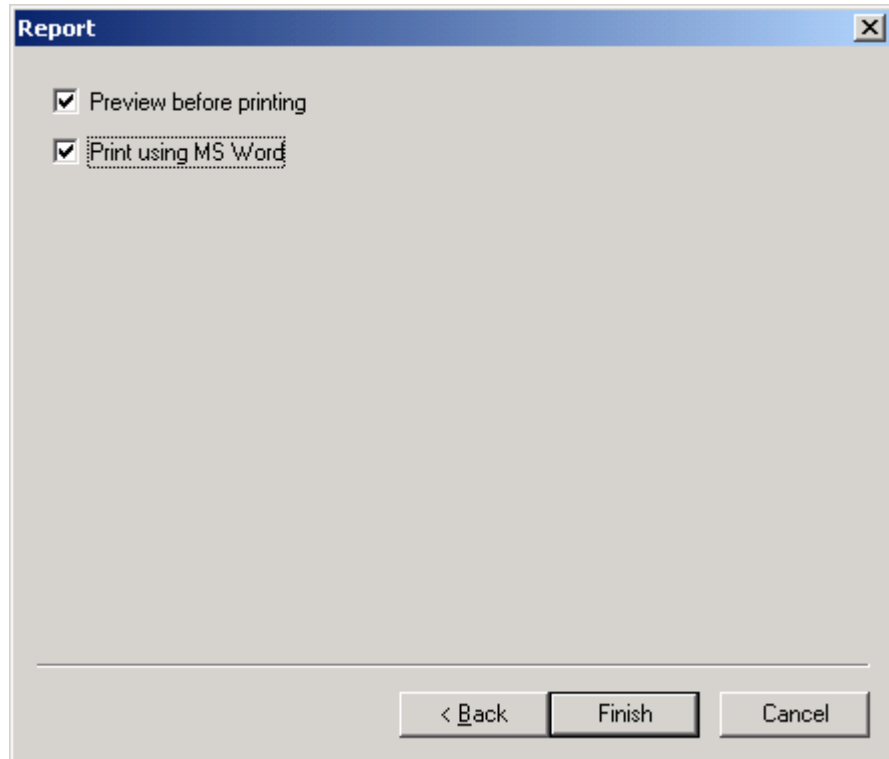
11. Click Preview Before Printing to check or clear the checkbox. If this option is checked, the report is displayed in Print Preview when the Print button is selected. In Print Preview, the technician can view the report, and then print or cancel printing. If this option is not selected, the report is sent directly to the printer when the technician clicks the Print button.

12. Click Print Using Word to check or clear the checkbox. If this option is checked, Microsoft® Word is opened and the report is printed. If this option is not selected, the report is sent directly to the printer when the technician clicks the Print button.

13. Click Finish to complete the initial setup and exit the setup wizard.

Setup LM 300

The LM 300 hardness tester's modes need to be set to the following configurations for the automated system and printer to operate.

Press DWELL/ENTER to change mode to the appropriate setting.

Mode 5	Host (For Automated System)	2
Mode 6	Printer Type Setting – RS232C	3

Setup LM 100

The LM 100 is pre-configured to the appropriate settings and needs no additional adjustments.

Configure AMH43 Software

The following procedures describe how to configure the AMH43 software with the hardware.

Check Turret and Objectives

1. Select the highest power objective in the Turret menu.
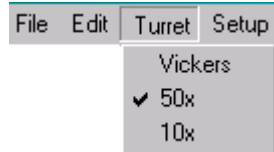
2. Confirm that the turret has rotated to the objective you selected.

3. If the turret should have rotated, but did not, cycle the power to the indenter and try again.

4. The small box in the lower right corner with the letters ipm indicates the indenter communication status. If the number inside the box is 0, the software is not able to communicate with the indenter. Check the hardness tester cable connections to make sure they are secure. Refer to Figure 2-2 AMH43 System Connections, page 2–5.

   Cycling the power on the tester will refresh the communication. Turn power Off, wait 5 seconds and then, turn power back On. Check ipm status.

5. If the turret turned to the wrong objective:

   A. Open the Camera dialog by selecting Hardware, Video from the Setup menu.
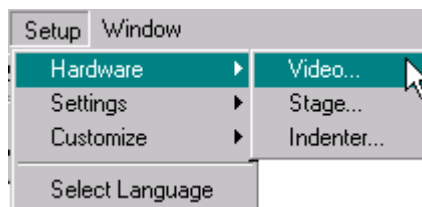
B. Click Properties from the Video dialog box.
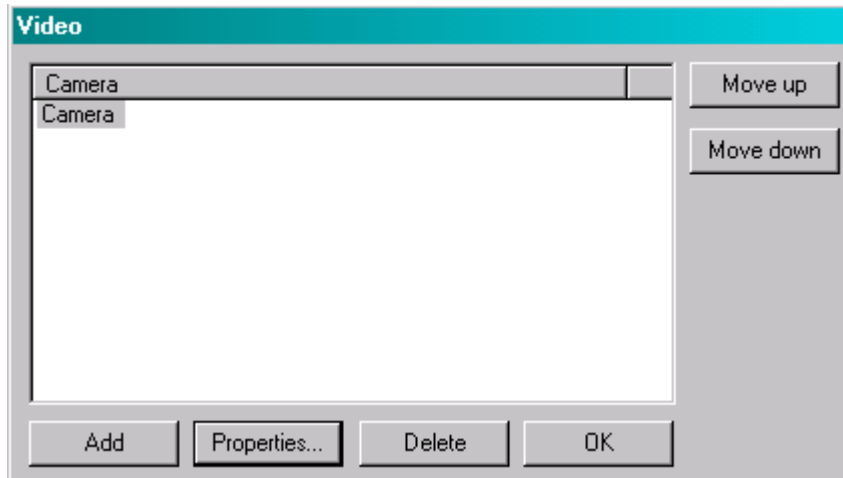
C. Rearrange the list of objectives so that they are in the correct position.
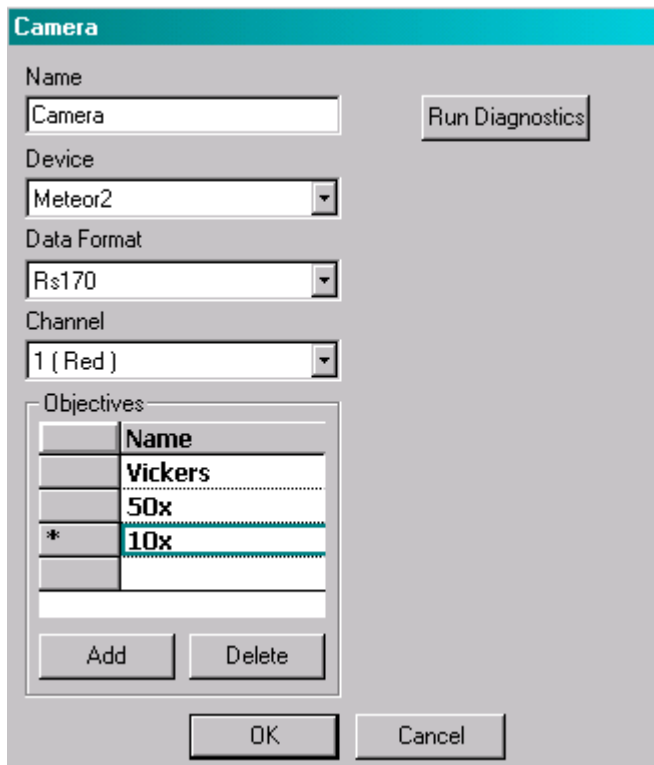
D. Click OK to close the Camera dialog box.

E. Click OK to close the Video dialog box.

F. Select the highest power objective from the Turret menu again.

Check Stage Settings

1. The LEDs labeled RX and TX on the stage controller box should be flickering continuously.

2. The small box in the lower right corner with the letters sps indicates the stage status. If the number inside the box is 0, the software is not communicating with the stage. Check the Hardware Tester cable connections to make sure they are secure.

3. Click the Snap button.

4. There should now be a pink crosshair with a box around it in the middle of the window. The pink crosshair represents the stage position. The box around the cross hair represents the area where the live image from the camera is displayed.
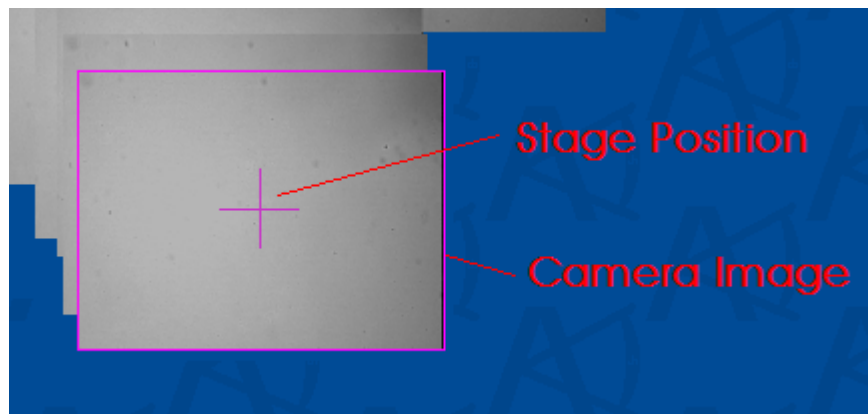
5. Click the Snap button again to deselect it. When Snap is selected (pressed in), the center of the window always snaps to the location of the stage.

6. Place the mouse one inch to the right of the pink crosshair.

7. Click and hold the left mouse button down for a couple of seconds. The pink crosshair should move to the mouse pointer.

8. Spin the mouse wheel (wheel is between left and right mouse buttons) a few ticks. The live image (pink box) should get bigger and smaller depending on which direction you spin the mouse wheel.

9. Spin the mouse wheel until the live image fills about 1 square centimeter of the image window area.

10. If you need to re-center the live image, either click the snap button twice, or click and hold down the right mouse button and move the mouse around until the live image is centered.

11. Use the mouse to move the stage to the right.

    A. Move the mouse cursor to the right of the stage location.

    B. While watching the stage, hold down the left mouse button for a couple of seconds.

    C. If the stage moved to the left:

        1) Select Hardware, Stage from the Setup menu to change the X direction toggle.
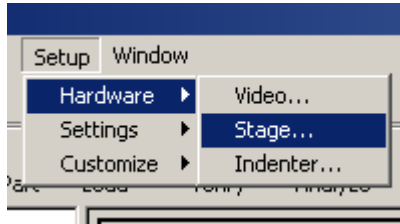
        2) Change both boxes labeled X and press OK.

    D. Click the Snap button twice to re-center the screen to the stage location.

    E. Move the mouse cursor below the stage location.

    F. While watching the stage, hold down the left mouse button for a couple of seconds.

    G. If the stage moved toward the back of the indenter:

        1) Change the Y direction toggle in the Stage Settings by checking both boxes labeled Y and press OK.

Configure Lighting

1. Press and turn the Focus Wheel until the stage is lowered enough to load a sample.

2. Place a sample on the stage or in the sample holder.

3. Use the mouse to move the stage so that the objective is centered above the sample.

4. Adjust the lighting of the hardness tester to a moderate level.

5. Move the stage back up until the sample is close to the proper distance from the objective. Use the Focus Wheel by either pressing and turning it simultaneously to move fast, or turning it without pressing it to move slower.

6. Adjust the lighting again if the image is too dark or bright.

7. If necessary, continue adjusting the lighting and stage height until the image looks in focus and with good brightness.

Pixel Calibration

1. Place a 0.01mm micrometer on the sample holder or stage in the horizontal direction.

2. Bring the micrometer into focus using a low power objective.

3. Move the stage position to the middle of the micrometer's measurement area or tick marks.

4. Adjust the micrometer position if needed so that it is horizontal and re-center the stage position if necessary.

5. Change to the highest power objective and refocus.

6. Select Settings, Objective Calibration, Manual from the Setup menu.
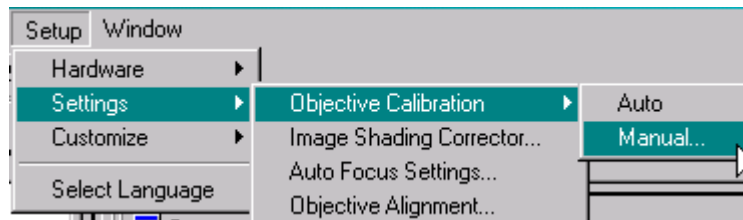
7. Click and drag the Horizontal Distance title bar to move the dialog box so that it is not obstructing the view of the image window.
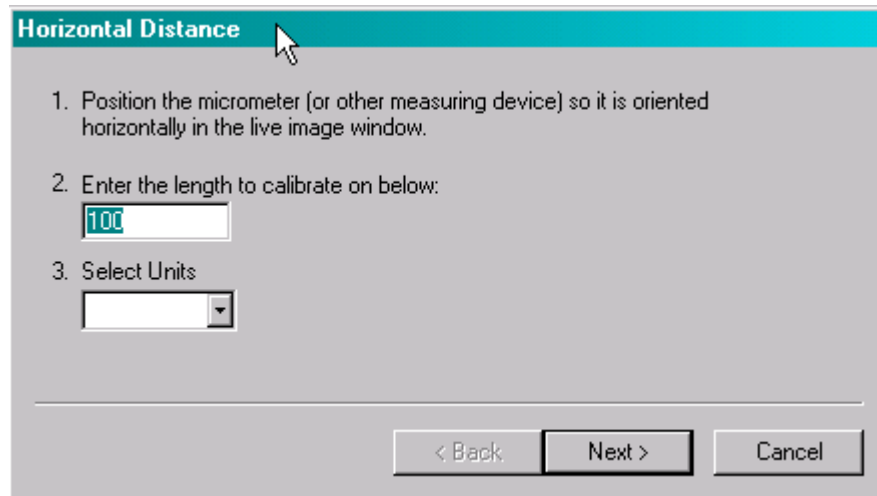
8. Click the Zoom to Live Image button:

---

9. The live image should now be filling most of the image view and the stage micrometer should be visible.

10. Enter a horizontal distance that is almost as wide as what can be seen on the micrometer in the live image window.

11. Click Next.

12. Adjust the vertical dotted red lines so that they span the distance on the micrometer entered in the previous step.
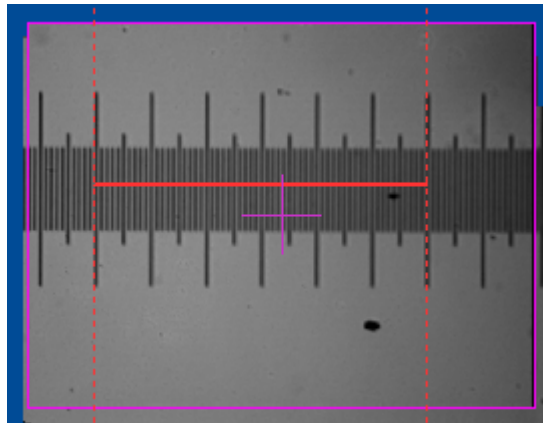
13. Click Next.

14. Reposition the micrometer so it is oriented vertically in the live image window. You may change to a lower power objective to help with repositioning, but change back to the original objective before continuing.

15. Enter the vertical distance that is almost as tall as what can be seen on the micrometer in the live image window.

16. Click Next.

17. Adjust the horizontal dotted red lines so that they span the distance on the micrometer entered in the previous step.
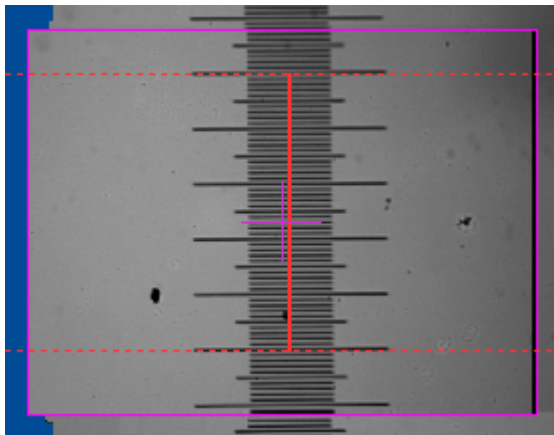
18. Click Finish.

19. Repeat the Pixel Calibration process for each objective.
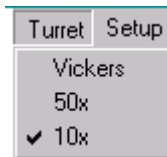
Parfocal Adjustment

1. Begin an auto focus procedure by pressing and releasing the Focus Wheel without turning it.

2. While the instrument is auto focusing, the crosshair blinks.

3. After the crosshair stops blinking, select the next lower power objective from the Turret menu.

4. Perform another auto focus.

5. Click OK when parfocal success dialog appears. If the dialog does not appear, parfocal adjustment failed. You must begin again with step 1 of this section using the highest power objective.

6. Perform the Steps 3-5 for all other lower power objectives.

Camera Alignment

Many times when the hardness tester is assembled, the camera is positioned so the horizontal and vertical directions in the camera image are not the same as vertical and horizontal movement directions of the stage. It is important that the camera and stage be as aligned as possible to have the most accurate measurements and for the panoptic image to be constructed correctly. The following procedure will align the camera with the stage.

1. Place any sample on the stage and bring it into focus using a low power objective.

2. Find any small mark on the surface of the part and move the stage so that the mark is in the upper left corner of the live image as shown below.
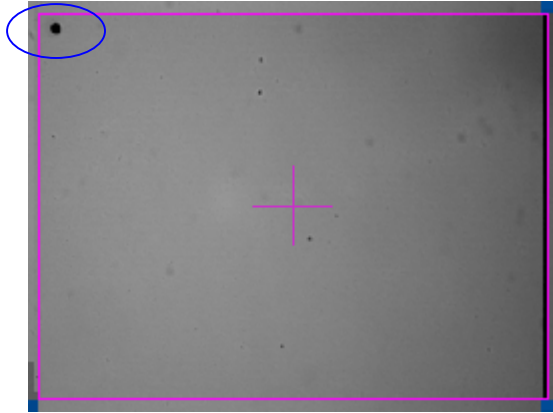

3. Press the Zoom Live button so the live image will fill most of the image view.

4. Select the Hardware, Stage from the Setup menu to open the stage settings dialog.
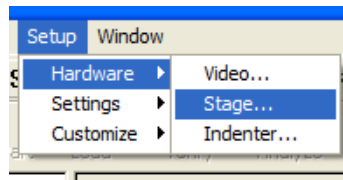
5. Note the distance between the mark and the top edge of the live image.

6. Use the X- button to move the live image to the left until the mark is in the upper right corner of the live image. If necessary, enter a smaller number in the Distance text box.
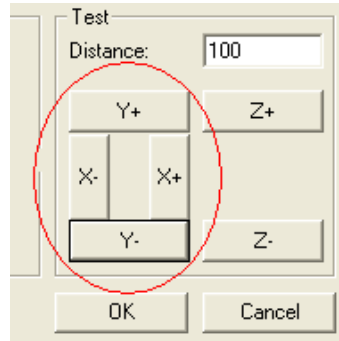

7. If the distance between the mark and the top of the live window has changed, twist the camera until the mark is closer to the same distance from the top as it was in the upper left corner.

8. Use X+ to the mark back to the upper left corner.

9. Continue adjusting the camera until the mark doesn't move vertically as the live image is moved left or right.

Objective Alignment

1. Load the calibration sample into the sample holder.

2. Change to a low power objective and center the sample under the objective.

3. Adjust lighting and bring the sample into focus.

4. Click the New button.
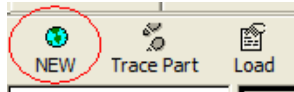
5. Click the New Indent button.
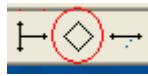
6. Click the Make Indent button on the new indent.

7. Wait for the indent to be made and measured.

8. If the indent was not measured correctly, click and drag the indent to a new location and click the make indent button again.

9. Right-click on the indent to display the context menu.

10. Click Align Objective.

11. Change the turret to the next lower power objective.

12. Focus the image.

13. Click and drag (left mouse button) the indent so that it is on top of the impression.

14. Click Align Objective from the indent context menu again.

15. Repeat the previous 4 steps using the other lower power objectives.

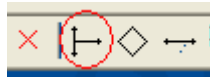16. Delete the indent by pressing the indent's delete button.

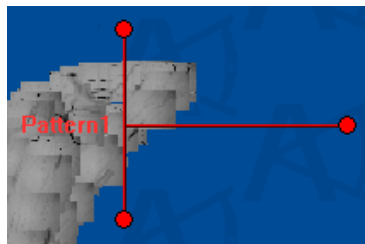## Measurement Calibration/ Application Setup

1. Click the New button.

2. Click the New Indent Vector button.

3. Double-click the indent vector labeled Pattern1.

4. Change the name of the pattern to Calibration.

5. Select the Indents tab.

6. Click the Add button.

7. Set the spacing to 250.

| ent	Distance	Spacing	Offset
	250.00	250.00	0.00

8. Click the add button 19 times so that you have 20 indents total.

| Indent	Distance	Spacing	Offset	Load	Est. Length	Est. Hardne	Circle Radius	Dwell
1	250.00	250.00	0.00	500	43.06	500.00	0.00	5
2*	500.00	250.00	0.00	500	43.06	500.00	0.00	5
3	750.00	250.00	0.00	500	43.06	500.00	0.00	5
4	1000.00	250.00	0.00	500	43.06	500.00	0.00	5
5	1250.00	250.00	0.00	500	43.06	500.00	0.00	5
6	1500.00	250.00	0.00	500	43.06	500.00	0.00	5
7	1750.00	250.00	0.00	500	43.06	500.00	0.00	5
8	2000.00	250.00	0.00	500	43.06	500.00	0.00	5
9	2250.00	250.00	0.00	500	43.06	500.00	0.00	5
10	2500.00	250.00	0.00	500	43.06	500.00	0.00	5
11	2750.00	250.00	0.00	500	43.06	500.00	0.00	5
12	3000.00	250.00	0.00	500	43.06	500.00	0.00	5
13	3250.00	250.00	0.00	500	43.06	500.00	0.00	5
14	3500.00	250.00	0.00	500	43.06	500.00	0.00	5
15	3750.00	250.00	0.00	500	43.06	500.00	0.00	5
16	4000.00	250.00	0.00	500	43.06	500.00	0.00	5
17	4250.00	250.00	0.00	500	43.06	500.00	0.00	5
18	4500.00	250.00	0.00	500	43.06	500.00	0.00	5
19	4750.00	250.00	0.00	500	43.06	500.00	0.00	5
20	5000.00	250.00	0.00	500	43.06	500.00	0.00	5

9. Click OK.

10. Position the indent vector so that it is completely within the sample area. Click and drag the circles to rotate, and click the lines to translate the indent vector.

11. Move the stage over the area covered by the indent vector and insure that no surface defects are underneath any of the indents. Move the indent vector to avoid any surface defects.
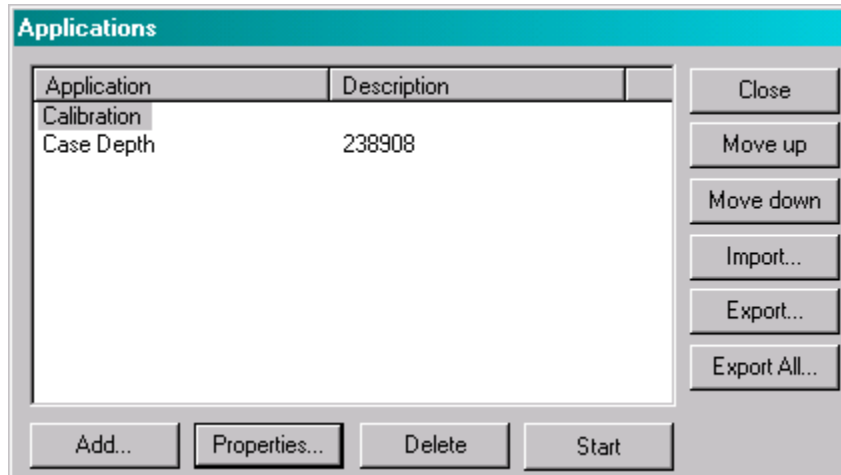
12. Click the Save Pattern Button.
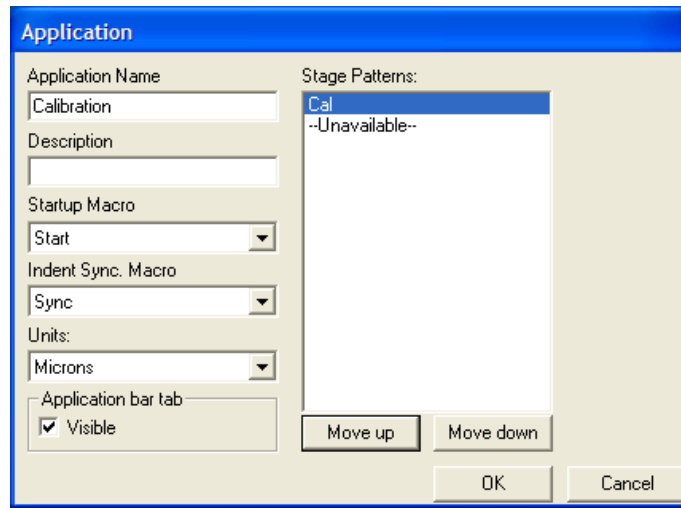

13. Enter Cal under Save As Stage Pattern.
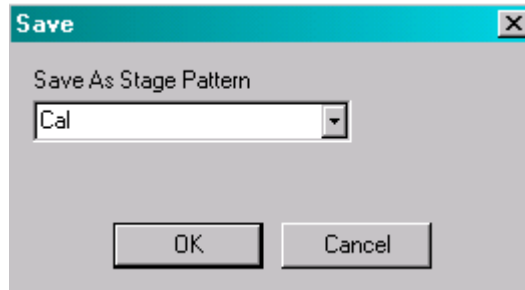
14. Select Customize, Applications from the Setup menu.
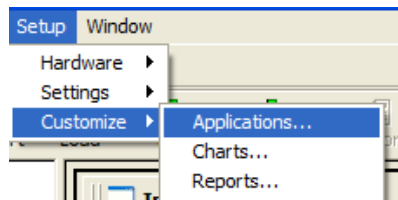
15. Select Calibration from the list and click the Properties button.
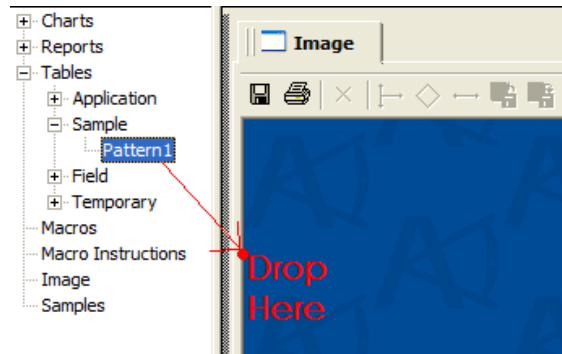
16. Select Cal from the list and press the Move Up button.
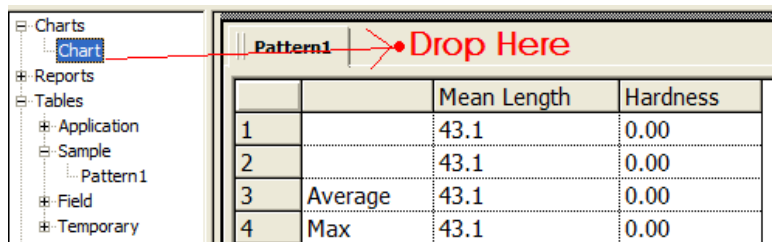

17. Click OK.

18. Click the Analyze button to begin the repeatability test.
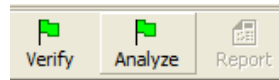
19. Drag and drop Cal sample table from the tree on the left, onto the left border of the image window.


20. Drag and drop the Chart from the tree on the left, onto the top border of the newly created table.


21. Wait for the analysis to finish.

22. Check results of the repeatability test using data in the table and chart.

23. At the bottom of the table, there should be two rows labeled R and E that will indicate either Pass or Fail.

24. If the R row indicates pass, but the E row indicates fail you need to set the measurement bias.

   A. Double-click the indent vector.

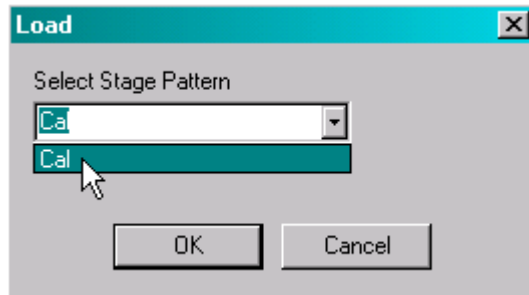   B. Select the Indents tab.

   C. Click the Set Bias button.
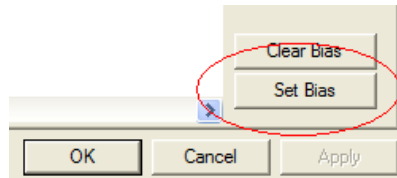
   D. Click OK.

25. In order to make sure the bias correction fixed the problem, you need to run the analysis again.

26. Click the New button.
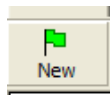
27. Click the Load Stage Pattern button:
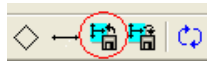

28. Select Cal from the drop-down list.

29. Click OK.

30. Reposition the indent vector so that it is not on top of any of the previously made impressions. You shouldn't need to move it far.

31. Click the Analyze button to begin the repeatability test and then, complete Step 19 - 22 again.

32. If E and R passed, the software has been installed and calibrated.

33. If it failed, the test may need to be repeated, or adjustments made to hardware/software settings, page 3–12 - 3–23.

System Security

Login passwords can be setup for a supervisor and a user. The supervisor password allows full access to the setup and analysis parameters, while the user password can be setup with limited access to the setup and analysis parameters.

Once a system login password is setup it must be entered before access to the AMH43 is allowed.

1. Select Customize Users from the Setup menu. The Users dialog box is displayed.
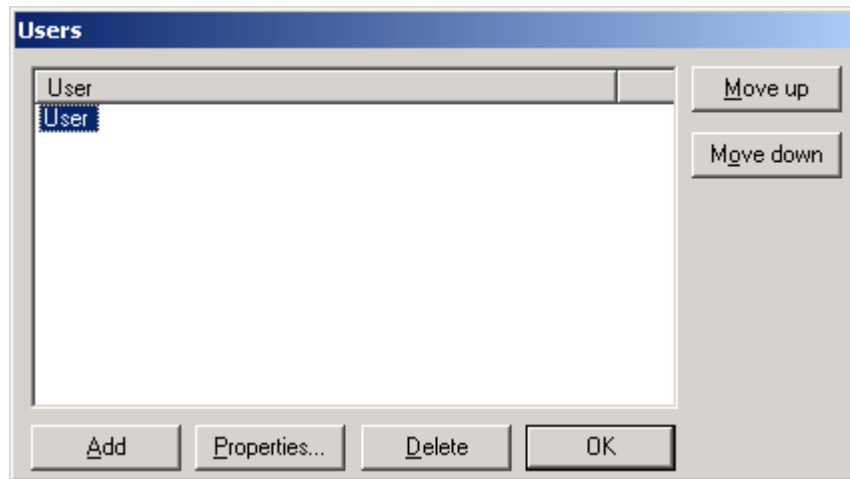

2. Click the Add button to add a new user.
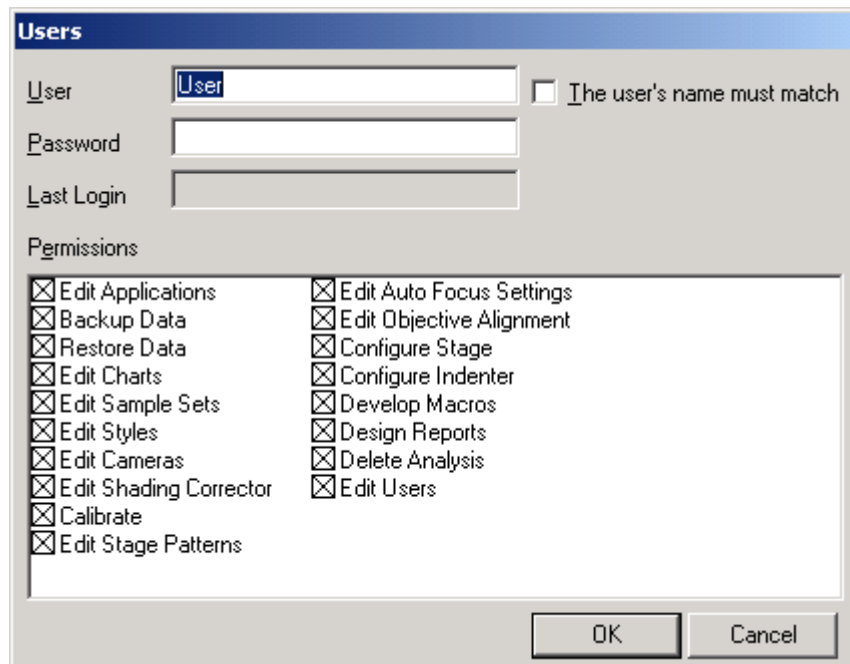
3. Enter a name for the user in the User field.

4. Enter a password for the user in the Password field.

5. To require a match of both the name and password before allowing access to the AMH43 software, click the User's Name Must Match checkbox. When a technician enters a name and password in the login dialog box, the system compares the entered name and password against all the users in the system. For those users added with "Name Must Match" checked, it requires a match of both the name and password. If this option is not checked, it disregards the user name and only compares the password.

Login

| User | User |
| Password | **** |

[OK] [Exit]
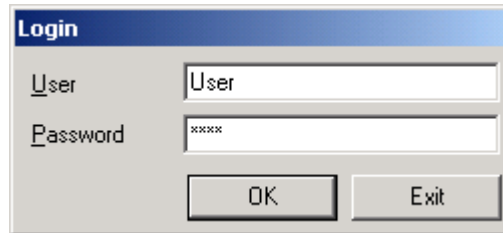
6. For each user, access to options can be selected by clicking on them in the Permissions section of the dialog box. A checkmark indicates access to that option will be allowed.

Calibrate Objectives

Correct reporting of the aspect ratio and calibration factor of the image pixels is vital in obtaining accurate data. Adjusting the horizontal and vertical ratio of the pixels ensures that the pixels are measured as square. Higher power objectives have lower calibration factors (fewer microns per pixel).

Be sure the calibration factor complies with the method standard to be used.

1. Select Settings, Object Calibration from the Setup menu.

Horizontal Distance

1. Position the micrometer (or other measuring device) so it is oriented horizontally in the live image window.

2. Enter the length to calibrate on below:

   100

3. Select Units

   [▼]

   [< Back] [Next >] [Cancel]

2. Position the stage micrometer so that the scale is horizontal.

3. Enter the length on which to calibrate. For example, 90.

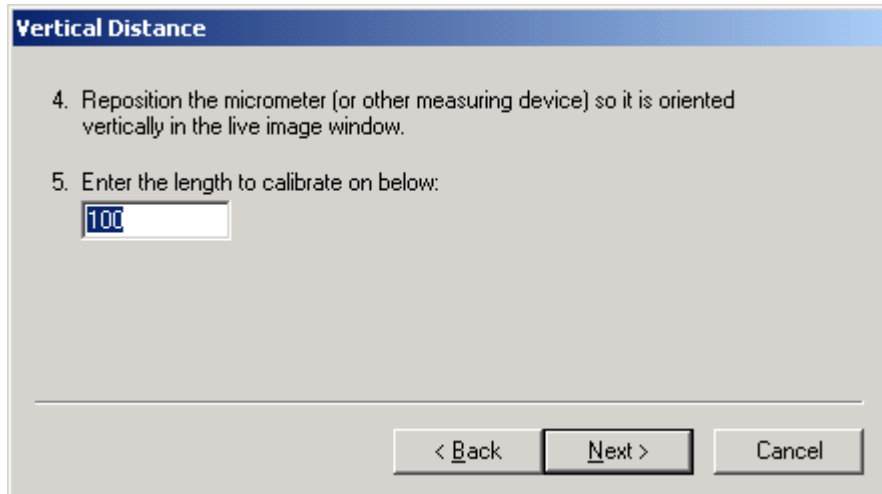4. Click Next. The Horizontal Measure dialog box is displayed.

Horizontal Measure

3. Click and drag horizontally over the micrometer in the image window. The length of this line should be 100.00.

   This is the resulting calibration:

   1

   [< Back] [Next >] [Cancel]

5. Adjust the measurement lines to span the entire calibration length. For example, 90.

6. The calibration factor is displayed.

7. Click Next. The Vertical Distance dialog box is displayed.

Vertical Distance

4. Reposition the micrometer (or other measuring device) so it is oriented vertically in the live image window.

5. Enter the length to calibrate on below:

100

< Back   Next >   Cancel

8. Position the stage micrometer so that the scale is vertical.

9. Enter the length on which to calibrate.

10. Click Next. The Vertical Measure dialog box is displayed.

Vertical Measure

6. Click and drag vertically over the micrometer in the image window. The length of this line should be 100.00.

This is the resulting aspect ratio:

1.033

< Back   Finish   Cancel
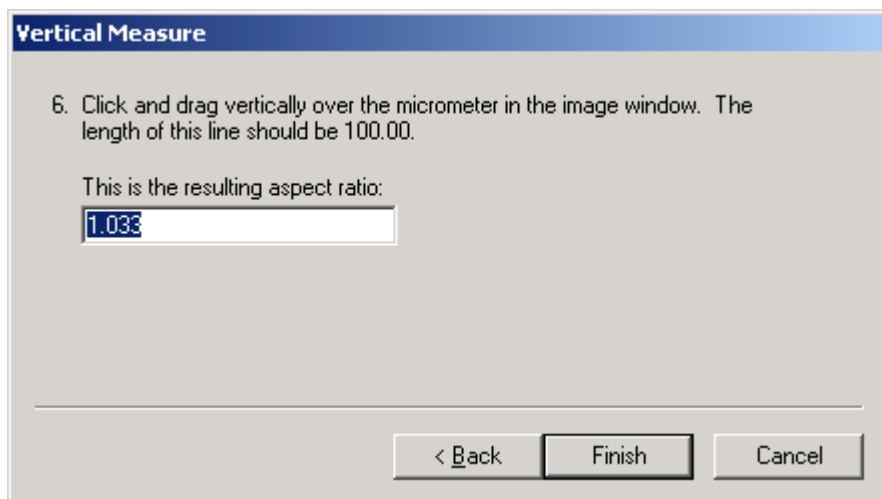
11. Adjust the measurement lines to span the entire calibration length.

12. The aspect ratio is displayed. For example, with a LECO supplied camera the aspect ratio is approximately 1.03.

13. Click Finish. These calibrated values are saved with the system configuration file.

# Setup the Image Shading Corrector

The Shading Corrector is used to create a reference image that compensates for uneven illumination.

The shading corrector can be turned off without destroying the file by deselecting the Shading corrector checkbox.

When using a low light level at low magnification, the room lighting may affect the shading of the image.

When initializing the shading corrector in low light at low magnification, dim the room lights and keep them low during the system operation.

1. Select Settings, Image Setting Corrector from the Setup menu.
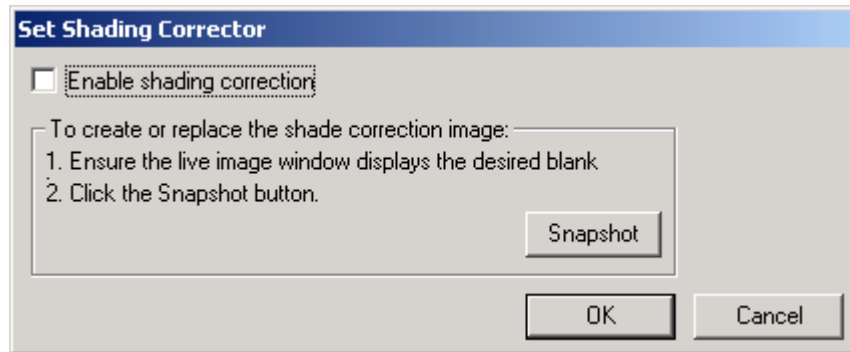
2. Place a blank, such as a mirror or bright surface under the lens.

3. Focus in on the mirror or bright surface.

4. Adjust the lighting to its brightest without reaching saturation. The image's color changes to magenta (bright pink) when it is saturated.

5. Click the Snapshot button to capture the reference image. Each time you click the Snapshot button it saves the current image; replacing any reference image saved previously.

6. Click the Enable Shading Corrector to check or clear the checkbox. If it is checked, the reference image is applied to any new image. If cleared, the true image is displayed without the reference image applied.

7. Click OK to exit the dialog box.

Setup the Auto Focus

The Auto Focus Settings command is used to define the automated stage's auto focus settings. These settings control the auto focus mechanism as it moves up or down along the Z axis to locate the best focus. The Auto Focus parameters are set at default values, which should be satisfactory for most applications.

1. Select Settings, Auto Focus Settings from the Setup menu.
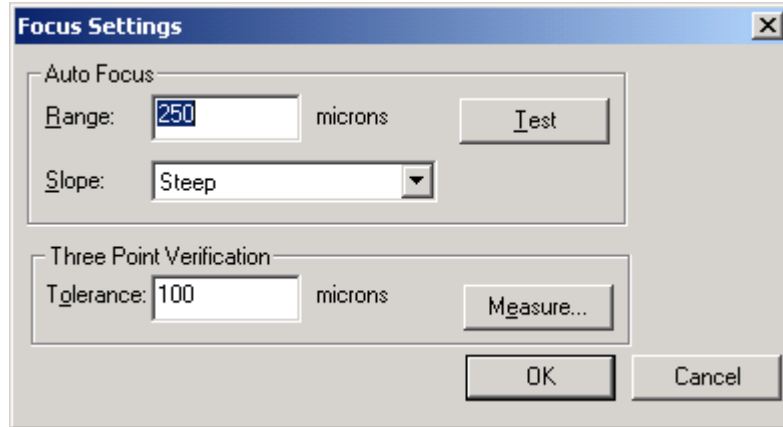
2. Click the Range text box, and then enter the range. The range is measured in microns. The range is the distance the auto focus mechanism travels during the auto focus sequence. For example, if the range is 500 microns, the auto focus mechanism travels 250 microns above and 250 microns below the original Z axis position.

3. Select the Slope by clicking the appropriate description in the dropdown list.

   Flat-the sample is not sloped.

   Sloped-the sample has a gentle gradient.

   Steep-the sample has a sharp gradient.

4. Click the Steps text box, and then enter the number of times to focus the image. A value of 2 through 50 must be entered. For example, if 10 is entered, 10 snapshots of the image are taken within the range. These snapshots are compared to determine the best possible focus.

5. Click the Test button to test the settings. The image should come into focus automatically.

6. Enter the Tolerance by using the joystick to move the sample to an area that is out of focus, but is still acceptable.

7. Use the joystick to move the sample to an area that is out of focus, but is still acceptable.

8. Click the Measure button to measure and record the tolerance. The Measure Stage Movement is displayed.

Measure Stage Movement ☒

Distance
Horizontal: 0
Vertical: 0
Focus: 0

Reset

OK   Cancel
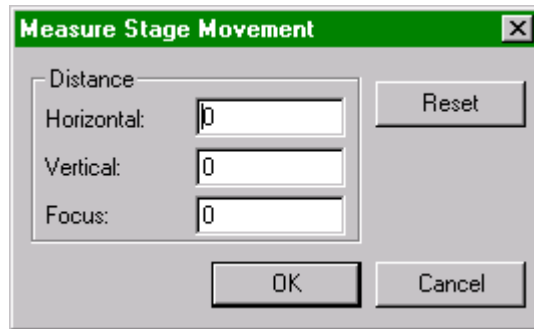
9. Use the joystick to focus the sample and record the Horizontal, Vertical, and Focus distance values.

10. To set the values back to 0, click Reset button.

11. Click OK to close the Measure Stage Movement dialog box.

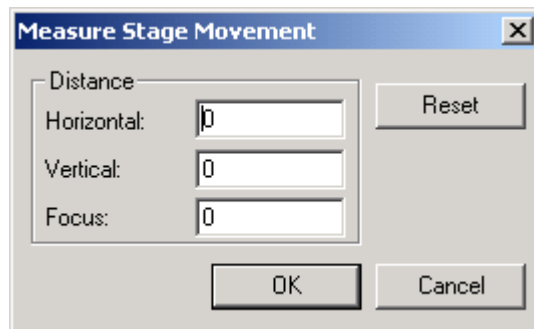12. Click OK to close the Focus setting dialog box.

Setup Objective Alignment

The Objective Alignment command is used to setup the X, Y and Z Axis parameter values.

1. Select Settings, Objective Alignment from the Setup menu.
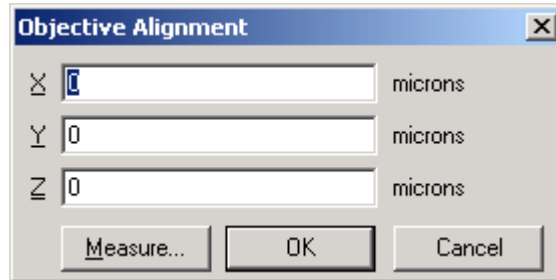
2. Enter the X Axis, Y Axis, and Z Axis parameter values.

3. Use the joystick to move the sample to an area that is out of focus, but is still acceptable.

4. Click the Measure button to measure and record the tolerance.

5. Use the focus wheel to focus the sample.

6. To set the values back to 0, click the Reset button.

7. Click OK to close the Measure Stage Movement dialog box.

8. Click OK to close the Object Alignment dialog box.

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4 Operation

Optimize System Performance

Several factors influence the performance and accuracy of the AMH43 system. The following information should be observed to optimize the system performance.

Specimens

Specimens used for micro-hardness testing need to be polished to ensure that the tips of the indents can be sharply focused. Specimens can be lightly etched to show micro-structural changes in the sample. However, too much etching makes the indent tips difficult to focus on.

It is necessary to have specimen surfaces perfectly perpendicular to the diamond indenter to ensure symmetrical indents. A self-leveling stage or leveling press can be effective in correctly positioning the samples.

Specimen surfaces must be clean. Dust and oily matter adhering to the surfaces make accurate measurements impossible.

If a square indent cannot be formed on a flat specimen, the problem may be a rough or uneven specimen surface. If another indent formed at a new location on the sample is still deformed, the specimen is probably tilted on the specimen table.

If a square indent cannot be formed on a curved (spherical or cylindrical) specimen, the top of the curved surface is probably not centered with the indenter tip. The top of the curved specimen is located in the direction of the pointed side of the indent. Use the fine adjustment controls to reposition the specimen.

Optics

The optics need to be clean. Any spots, dust, etc., result in poor focusing and poor data.

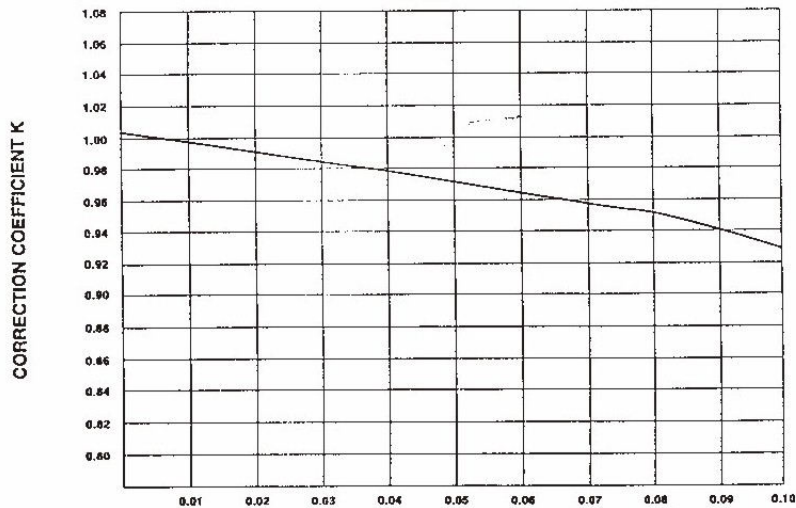## Correction Coefficient for Measuring Cylinders

According to the test procedures specified by ASTM and the Japanese Industrial Standards, specimen surfaces should, in principle, be flat. However, it is impossible to prepare flat surfaces for certain types of specimens. The correction coefficients for curved specimens (cylinder or sphere) are illustrated below. The illustrations are for general reference and for correcting contact area.
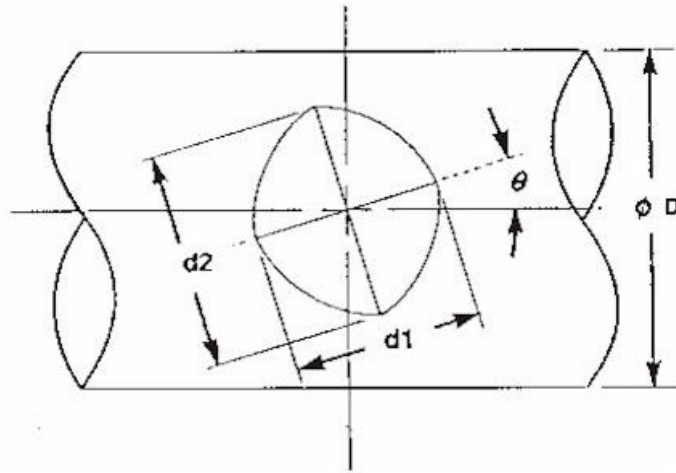
True Hardness = (Correction Coefficient) X (Apparent Hardness)

"Apparent Hardness" means a hardness value obtained by regarding the indentation shown above as one formed on a flat surface and having a diagonal dm = (d1 + d2)/2.

Angle θ can be optionally selected.

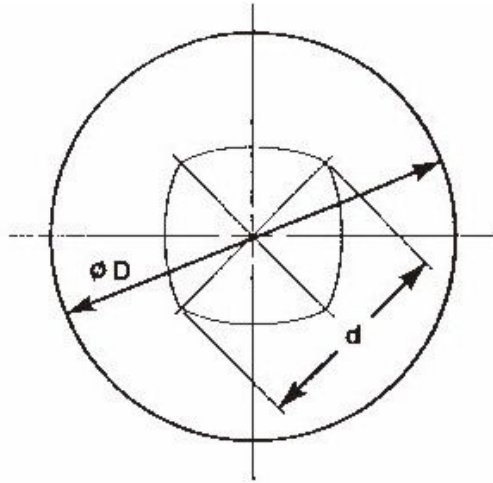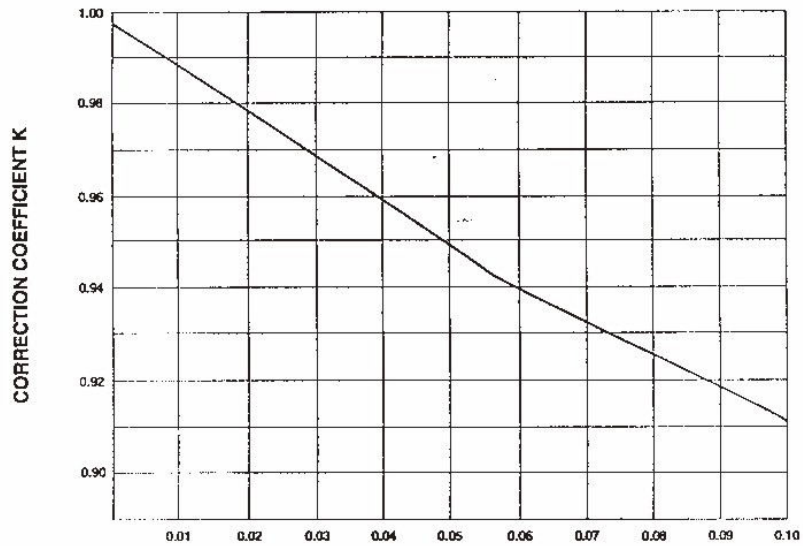## Correction Coefficient for Measuring Spheres

True Hardness = (Correction Coefficient K) x (Apparent Hardness)

"Apparent Hardness" means a hardness value obtained by regarding the indentation shown above as one formed on a flat surface and having a diagonal d.

Ratio of Diagonal Length of Indentation to Diameter of Sphere (d/D)

Indenter

Keep the tip of the indenter clean. Indents formed on a contaminated specimen or with a contaminated indenter cannot be accurately measured. Dust and/or oil adhering to the perimeter of the indent obscures the measurements.

To clean the indenter, gently wipe it with a clean cloth dampened with alcohol or benzine. An unstarched cotton cloth or a cotton swab is recommended.

Do not bump the diamond indenter or indenter shaft. Avoid shocks to the indenter.

The indenter shaft is equipped with an adjusting shim, which allows the user to adjust the position of the indenter. This shim ensures the inter-changability between Knoop and Vickers indenters. Do not detach the adjusting shim.
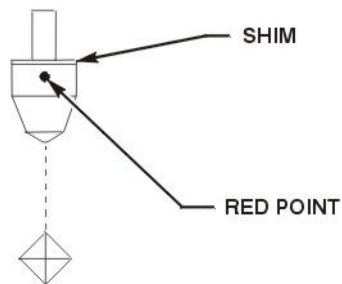

Figure 4-1
Indenter Adjusting Shim

Vickers indenters are square-based pyramidal diamonds. A Vickers indent penetrates the material approximately 1/7 the measured diagonal length. Since the Vickers indenter penetrates deeper into the material being tested, a Vickers indent is less sensitive to surface conditions. And, because the Vickers indenter diagonal is shorter in length, it is more sensitive to errors in measuring.

Knoop indenters are elongated, rhombic-based diamonds. A Knoop indent penetrates the material approximately 1/30 of the measured diagonal length. The Knoop indent, with a longer diagonal, is less sensitive to measuring errors, and more sensitive to surface conditions. Knoop indents are particularly sensitive to surface conditions when using light loads.

The red dot (shown in Figure 4-1, page 4-6) located on the indenter is used for judging the direction of the indent.

Indents

An accepted protocol for spacing hardness indents is to keep indents at least two diagonal widths apart. This eliminates the second indent being affected by deformation resulting from the first indent.

If hardness indents are non-symmetrical after leveling the specimen, check the following:

Specimen still not perfectly level.

Indent taken too close to a surface.

Surface rounding may occur due to polishing procedures.

Indent taken partially in a hard, or soft, micro-constituent. For example, a large carbide particle in a ferric matrix.

Metal build-up on one side of the diamond indenter after moving the indenter across the specimen.

If the indents are symmetrical, but have a stain around them, it is usually due to moisture on the specimen surface, or moisture condensation on the indenter. Wipe the indenter clean with a soft cloth or lens tissue.

Test Blocks

Be sure the test blocks and all system components are at ambient temperature before performing hardness testing or calibrations. Variation in test block hardness and indent measuring errors are greater than the measuring accuracy of the hardness tester. The accuracy of hardness measurements is dependent on the measuring accuracy of indents. The test block has standard indents for reference sizes.

Different test loads may provide different hardness values for the same specimen. The test report lists hardness values with corresponding test loads.

To clean the test block, wipe it with a clean cotton cloth dampened with acetone or benzine. The test block should be stored in a dessicator to prevent corrosion. Do not apply oil or powder anti-corrosives.

AMH43 System Overview

The AMH43 system features a unique patent pending visual method for sample reconstruction along with advanced image-recognition technology that allows you to analyze information unavailable with limited threshold-based methods.

Perfect for a number of applications including case-depth analysis, surface analysis, weld profiles, and coating hardness, the AMH43 easily measures impressions of various surface conditions, including scratched/etched or unevenly illuminated surfaces.

As you explore the sample or allow the operating software to trace the outline of the sample for you, an overview is automatically constructed. Shape, location, and estimated size of each indent are conveniently shown prior to indentation, helping you avoid surface imperfections and improving production. Position indents and patterns directly over a single panoptic image of the sample part for the most complete view available.

The AMH43 system also features valuable tools that add convenience to your work, such as a configurable user interface, professional report designer, and optional macro language. A newly designed vice-lock sample holder quickly levels mounted parts, free of protrusions above the sample surface.

AMH43 Main Window

The AMH43 Main Window contains all the result, sample, pattern, and report data.
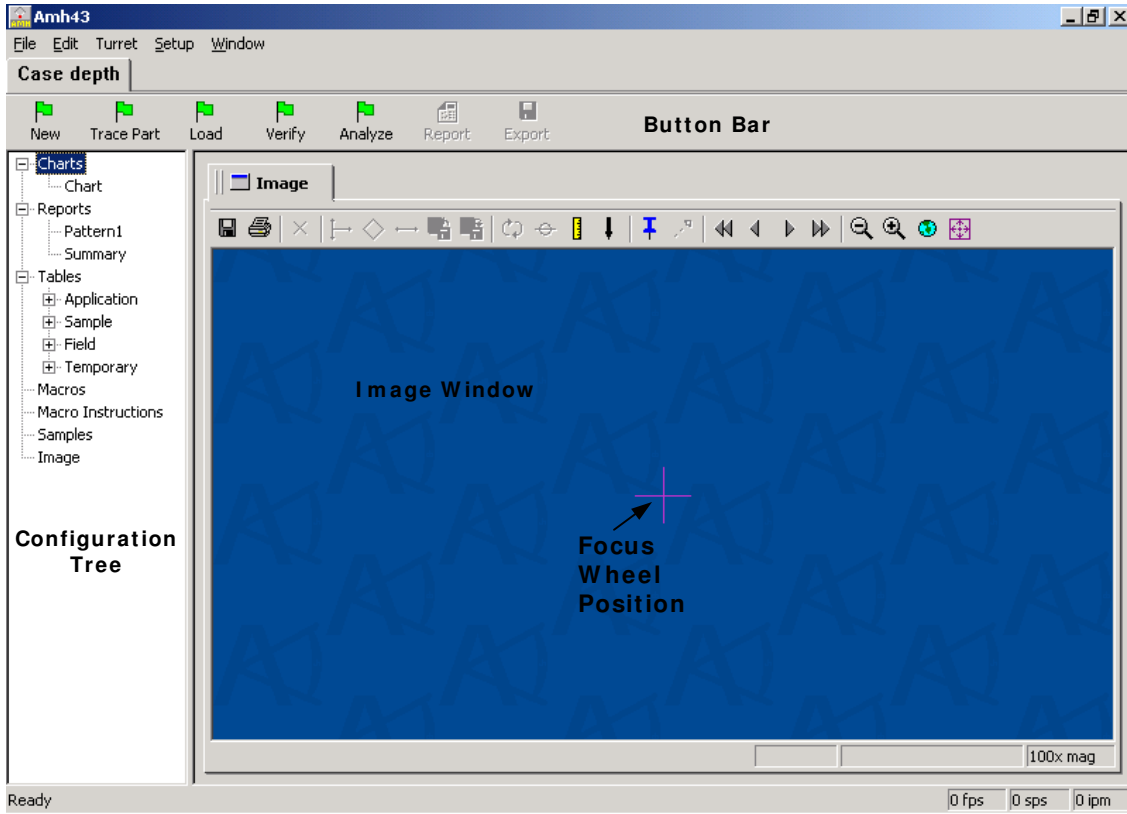
Charts

When an application is created, a sample chart is automatically created for that application.

Click and Drag

To open the Chart, click and drag the chart's name out of the Configuration Tree. Charts can be modified using the Customize, Charts option in the Setup menu. Right-click on the Chart tab and select Close to close the chart.

Reports

When an application is created, a sample report and summary report are automatically created for that application. To open the Report, click and drag the report's name out of the Configuration Tree. Reports can be modified using the options on the Report menu. Right-click on the Report tab and select Close to close the report.

Tables

When an application is created, several tables are automatically created for that application. To open the Table, click and drag the table's name out of the Configuration Tree. Tables can be modified using the fields in the Tables pane. Right-click on the Tables tab and select Close to close the table.

Macros

When an application is created, a macro is automatically created for that application. To open the Macro, click and drag the macro's name out of the Configuration Tree. Macros can be modified using the Toolbar buttons in the Macros pane. Right-click on the Macros tab and select Close to close the Macros.

Macro Instructions

When an application is created, a macro is automatically created for that application. To open the Macro Instructions Toolbox, click and drag the macro's name out of the Configuration Tree. Macro Instructions can be modified the Toolbar buttons in the Toolbox pane. Right-click on the Toolbox tab and select Close to close the Macro Instructions Toolbox.

Samples

A Sample spreadsheet grid which records and tracks data for individual samples is created for each application. To open the Sample spreadsheet, click and drag the Sample's name out of the Configuration Tree. Sample grids can be modified and using the Customize, Sample Setup option in the Setup menu. Right-click on the Sample tab and select Close to close the Sample spreadsheet.
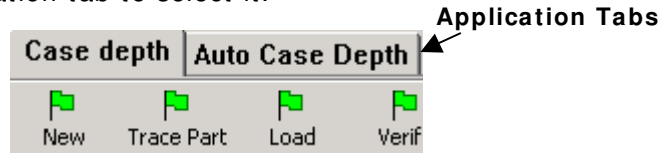
Image

The Image window automatically displays the live image in panoptic format. Use the commands on the Image toolbar to manipulate the image for analysis. To close the Image Window, right-click on the Image tab and select Close.

Performing an Analysis

After the system setup is complete, actual sample analysis can be performed using the following steps.

1. If you are using multiple applications, click the appropriate application tab to select it.

    Application Tabs

2. Place the sample and focus the microscope or optical device.

3. Set the lighting by pushing down the center button on the Focus Wheel and holding it for a few seconds. The Powermate Image Source dialog box is displayed.
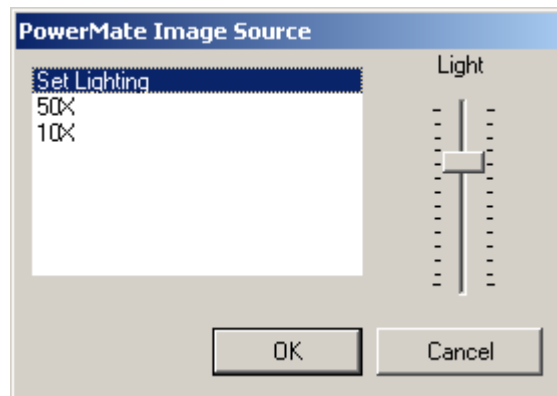

4. Rotate the Focus knob to move through the options in the dialog box and select Light. Adjust the lighting and press the top of the knob to set the lighting and leave the dialog box.

5. Focus the sample by taping the top of the Focus knob.

6. Click the New button to start a new analysis and clear the screen. If Prompt for Sample Data is selected in the application, the Enter the Sample Data dialog box is displayed.

Enter sample data

|	Sample	Description	Comments	Operator
1*	Sample			

7. Enter the appropriate sample information and click OK.

8. Move to an edge of the part by dragging the window with the mouse. Position the window over the edge of the part so that part of the mounting material (black) is shown.

9. Click the Trace Part button to automatically trace around the contours of the part.

10. Once the part is traced, click the Trace Part button to stop the trace.

11. Right-click and hold to position the image in the Image window.

12. Click the Load button and select the Stage Pattern from the dropdown list and then click OK.

Select Stage Pattern

Test1

13. Use the mouse wheel to zoom in and then click and drag any of the 3 points to rotate the Test pattern.

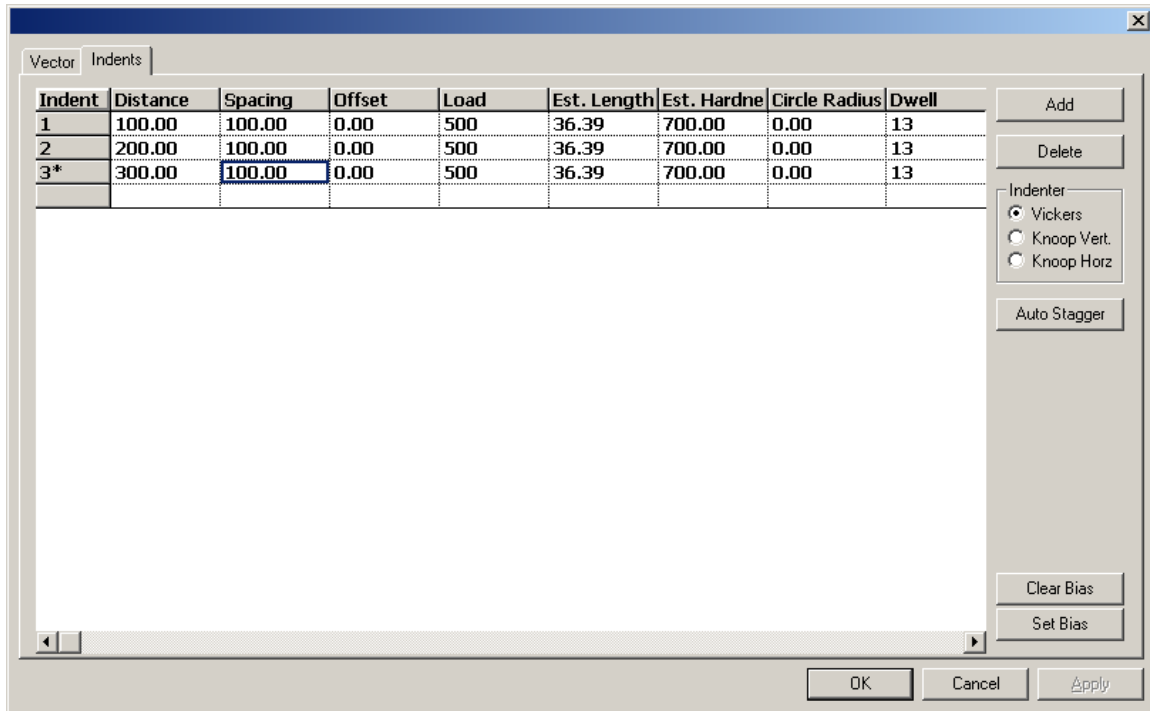14. To move the Test pattern, click and drag the bar rather than the end points.

15. To resize the Test pattern, click and drag any of the 3 points.
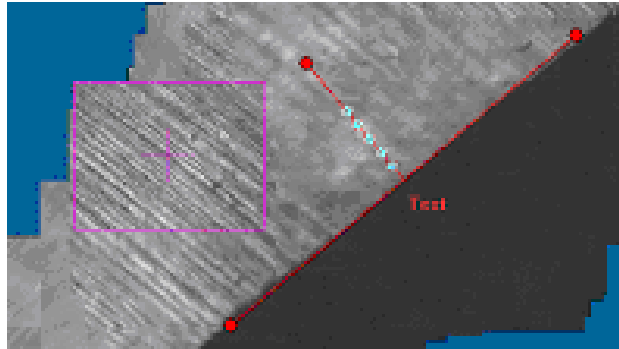
16. Click the Load button and add as many patterns as necessary. Generally, Test patterns are placed at each corner.

17. Once all patterns are added and moved into place, click the Verify button to move to each Test pattern and verify that each is correctly positioned.

18. To adjust any of the Test patterns, double-click the bar and make the necessary corrections to Vector tab.
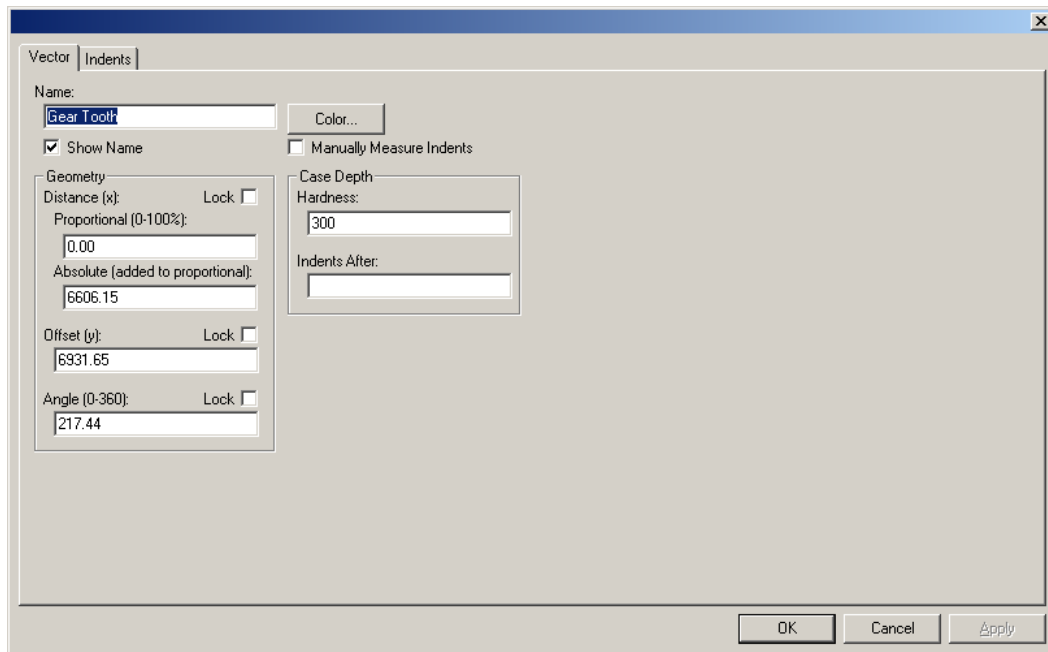
19. Enter a descriptive name in the Name text box to help identify the pattern.

20. Click the Indents tab to enter the placement information for each indent.

21. Enter the Distance, Offset, and Angle for placement of the indents. Click the Lock checkbox to prevent the indent position from being moved or leave unchecked to click and drag the indent marker to a new location directly in the image window.

Indent-A list of indents.

Distance-The distance from the starting point for the indent. This can be a numerical number or a percentage. A percentage can be used to space a given number of impressions per the vector of positioning line distance.

Spacing-The amount of space between each indent.

Offset- The distance perpendicular to the line.

Load-The load for the tester being used. The load is located on the microhardness tester's weight knob.

Est. Length-The estimated length of the indents.

Est. Hardness-The estimated hardness of the indents. The indent is drawn based on this amount.

Circle Radius-The radius boundary to maintain around each indent. This will place a circle around the diamond indent area so that ASTM standards can be maintained.

Dwell-The software reads the dwell time from the micohardness tester.

22. Click the Add button to add indents.

23. Click the Delete button to remove indents.

24. Select the type of microhardness tester used.

25. Enter the percent of Error Tolerance.

26. Click the Autostagger button to place the indents as close as the ASTM standard allows.

---

27. Click the Set Bias button to calibrate the load to a standard test block.

28. Click the Clear Bias to remove the load bias.

29. Click OK to close the dialog box.

30. Click the Analyze button to indent and measure the sample. The sample is automatically focused before the indents are made and the measurements are taken.

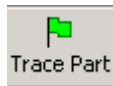31. To print the results, click the Report button.

Clearing the Image

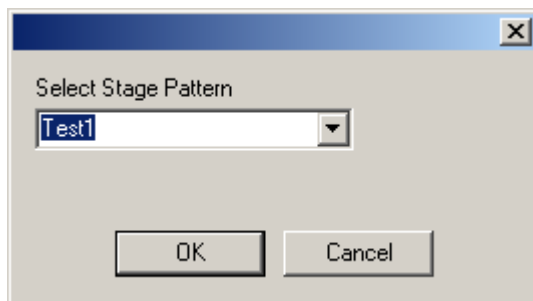Click the New button to clear the image from the image window and load a new part.

Tracing the Parts

Click the Trace Part to trace the contours of the part. Once the part is traced, click the Trace Part button to stop the trace.

Loading Stage Patterns

Load the stage patterns by clicking the Load button and select the stage pattern from the dropdown list.


Verify Patterns

Click the Verify button to verify the placement of the indent patterns and indents before actually starting the analysis.

Verify

Indent and Measure Samples

Click the Analyze button to Indent and Measure the samples to obtain the hardness values. The system can measure all the unanalyzed samples or just the samples selected in the Sample window.
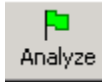
Analyze

To measure a specific sample, select the entire sample row in the Sample window and then click the Analyze button.

	Sample	Description	Comments	Operator	AnalysisDate
1	Sample				
2	Sample				06/12/03
3	Sample				06/12/03
4	Sample				06/12/03
5	Sample				06/12/03
6	Sample				06/12/03
7	Sample				06/12/03
8	Sample				06/12/03
9	Sample				06/12/03
10	Sample				06/12/03
11	Sample				06/12/03
12	Sample				06/16/03
13*	Sample				06/16/03

To measure all the unanalyzed samples added to the Sample window, click the Analyze button. The system loads all samples not already loaded.

The results for all the samples are displayed in the Sample window.
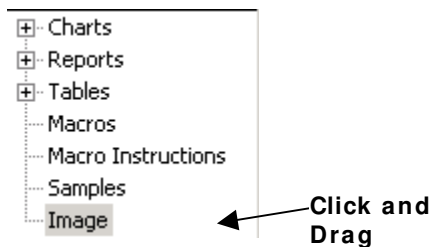
Image Window

The Image window displays the live image. Use the commands on the Image toolbar to position, set patterns, make indents and measure the image displayed.
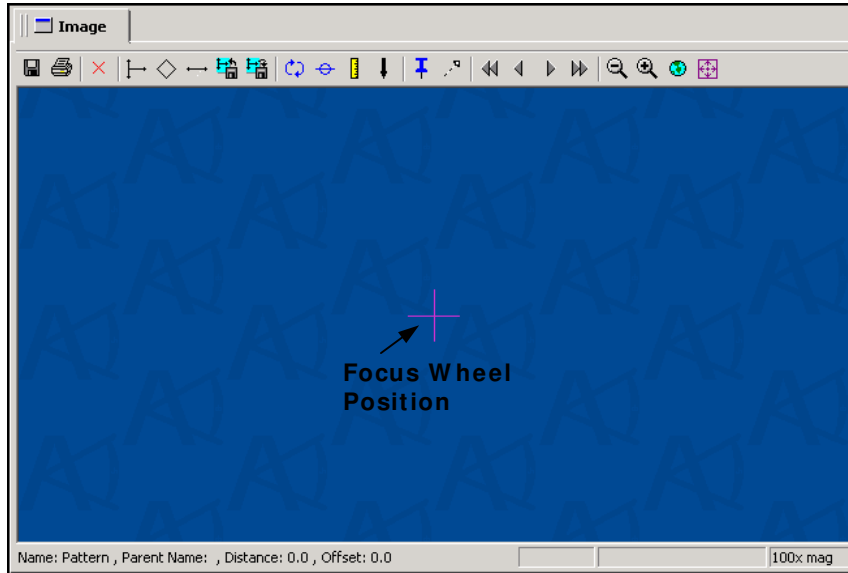

Additional Image windows can be opened to show different aspects of the part such as the entire part in one window and an area of interest in another.

To open additional windows, click and drag the Image name out of the Configuration Tree.


To reposition an Image Window, right-click on the Image Tab and select Detach from the menu. Once the window is detached, click and drag the title bar to move it.
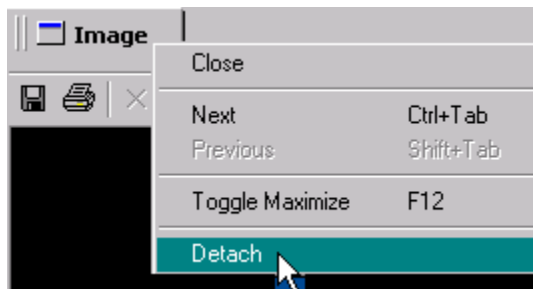
Right-click the Image tab and select Close to close the Image window. This menu also allows you to move to the Next or Previous windows, toggle between a maximized or minimized screen or Detach connected windows.
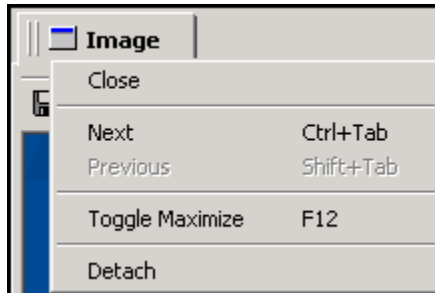
Click the Save button to save the image as a Portable Network Graphic (PNG) file.

Click the Print button to print the panoptic image.

Click the Delete Selected Item button to remove the selected item such as a pattern, indent, or positioning line.

Click the New Indent Vector button to add indent patterns.

Click the New Indent button to add indents to the Indent Vector.

Click the New Positioning Line button to add a guide line for the sample.

Click the Load Stage Pattern button to add a stage pattern.

Click the Save Stage Pattern button to save a new stage pattern.

Click the Trace Sample Edge button to trace along the contours of the sample.

Click the Focus button to automatically focus the sample.

Click the Measure Indents button to measure an indent.

Click the Make Indents button to create the indent.

Click the Snap to Stage Position button to place the live image in the center of the Image window.

Click the Display Pattern Dependencies button to place a dependency arrow on the pattern.

Click the Go to Previous Pattern button to move to the previous patterns.

Click the Go to Previous Indent button to move to the previous indent on the pattern.

Click the Go to Next Indent button to move to the next indent on the pattern.

Click the Go to Next Pattern button to move to the next pattern.

Click the Zoom Out button to view a larger portion of the sample in the Image window.

Click the Zoom In button to magnify the part.

Click the Show Whole Part button to make the image as large as possible while keeping the entire part in view.

Click the Zoom to Live Image button to move to the live image quickly.

Panoptic View

As you explore the sample or allow the operating software to trace the outline of the sample, an overview is automatically constructed. The software then combines the overview image, camera image, and patterns in one Panoptic view. Shape, location, and estimated size of each indent are conveniently shown prior to indentation, helping to avoid surface imperfections and improving production.
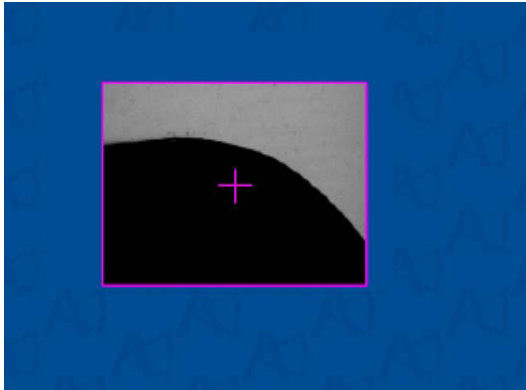
Live Image   **Panoptic View**
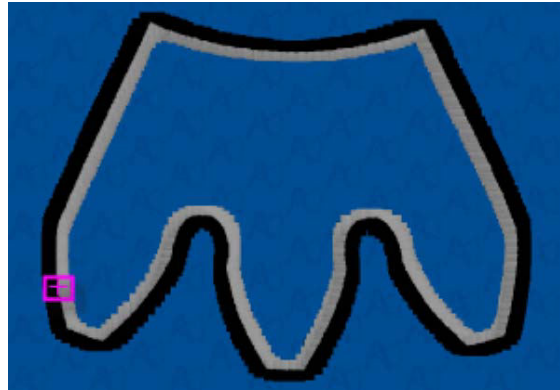
Tracing the Sample Edge

The following procedure traces the edge of the sample providing an exact outline of the sample for ease in positioning the impressions.

1.   Place the sample in the sample holder and focus the microscope or optical device.

2.   Select the highest power objective in the Turret menu.
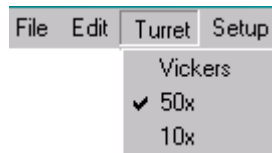
3. Move to an edge of the part by dragging the window with the mouse. Position the window over the edge of the part so that part of the mounting material (black) is shown.

4. Click the Trace Sample Edge button to automatically trace around the contours of the part.

5. If the Trace Speed is too fast or too slow, select Hardware, Stage from the Setup menu.
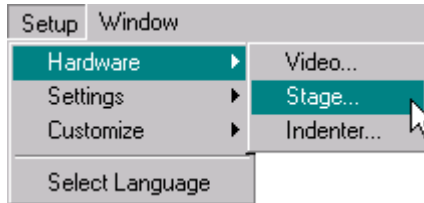
6. Adjust the Trace Speed as needed.
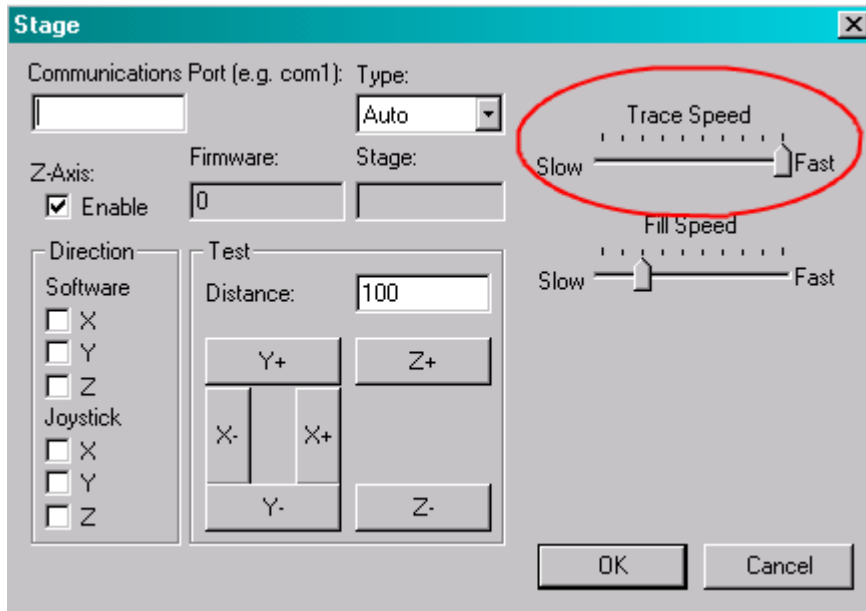
7. Once the part is traced, click the Trace Sample Edge button to stop the trace.

8. Click the Zoom Out button to view the entire image in Panoptic view.

9. Create a second Image window by clicking and dragging the Image name out of the Configuration Tree.

⊞ Charts
⊞ Reports
⊞ Tables
— Macros
— Macro Instructions
— Samples
— Image ← **Click and Drag**
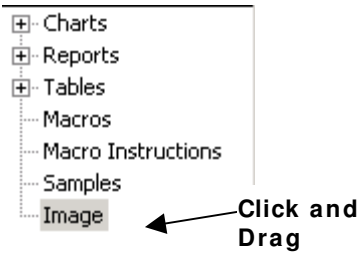
10. One Image Window shows the Panoptic view and the other shows the Live image.
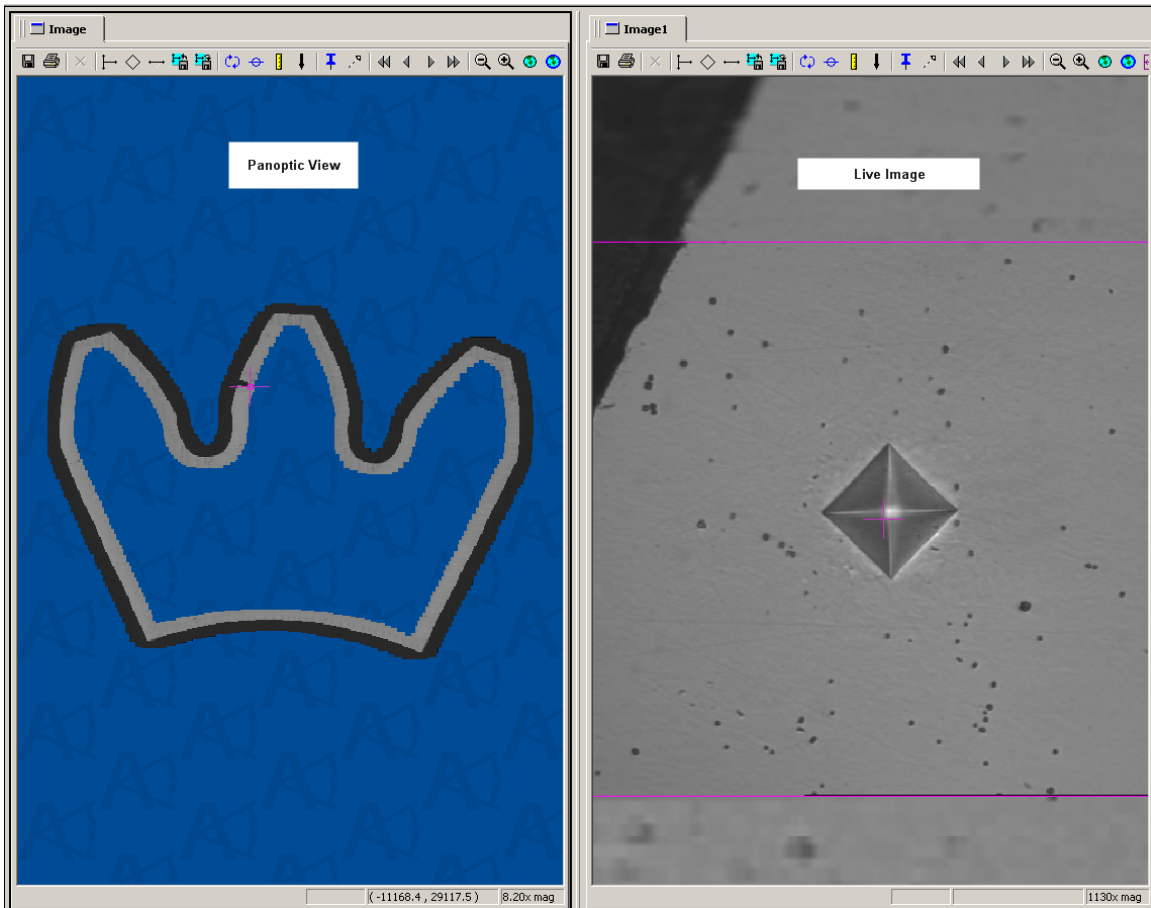
Panoptic View

Live Image

(-11168.4 , 29117.5)   8.20x mag

1130x mag

11. To reposition an Image Window, right-click on the Image Tab and select Detach from the menu.

	Image	
Close	
Next	Ctrl+Tab
Previous	Shift+Tab
Toggle Maximize	F12
Detach	
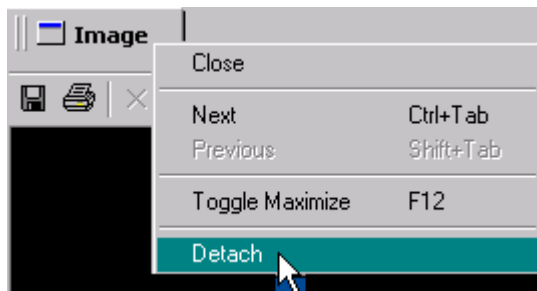
12. Once the window is detached, click and drag the title bar to move it.
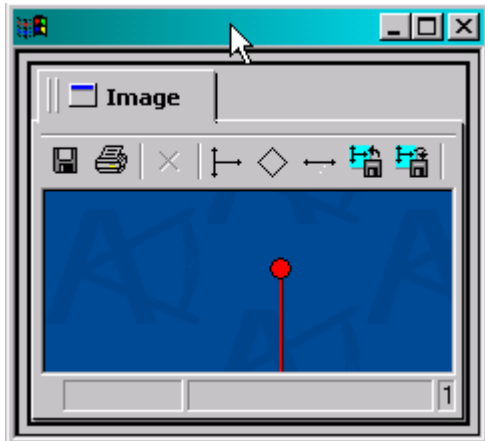
13. The window can also be resized by placing the cursor on clicking over one of the edges. When the resizing arrow is displayed, click and drag the edge to the appropriate size.

14. To close an Image window, right-click on the Image tab and select Close.

Positioning Patterns

A new pattern can be created and the traverses positioned exactly where required.

1. Click the New Indent Vector button to create a pattern on the Panoptic view. A Pattern is placed on the image.

2. Use the mouse wheel to zoom in and then, click and drag any of the 3 points to rotate the Pattern.
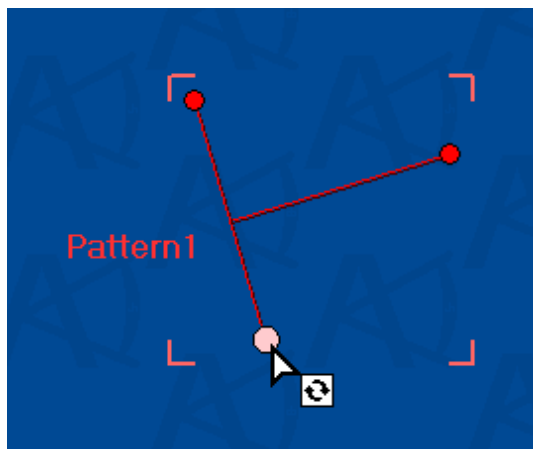
3. To move the Pattern, click and drag the bar rather than the end points.
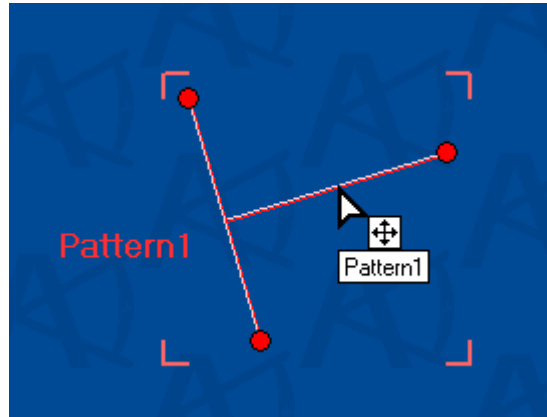
4. To resize the Pattern, click and drag any of the 3 points toward or away from the bar.
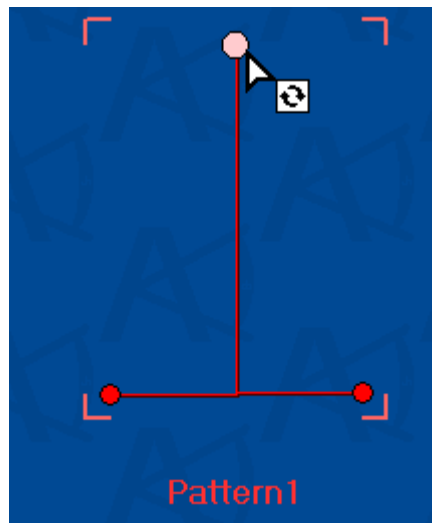
5. Click the New Indent button to add as many indents as are needed to the pattern.

6. The indent positions are displayed on the pattern.
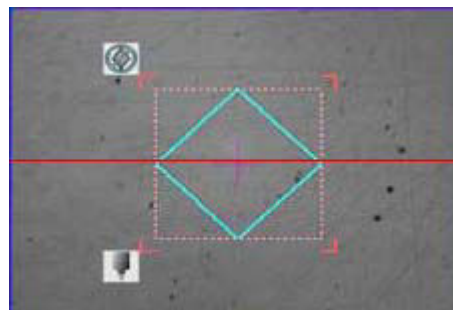
7. Double-click the Pattern to display the properties and then, click the Indents tab.

Indent	Distance	Spacing	Offset	Load	Est. Length	Est. Hardness	Circle Radius	Dwell	Objective
1*	100.00	100.00	0.00	500	43.06	500.00	0.00	13	50x
2	200.00	100.00	0.00	500	43.06	500.00	0.00	13	50x
3	300.00	100.00	0.00	500	43.06	500.00	0.00	13	50x
4	400.00	100.00	0.00	500	43.06	500.00	0.00	13	50x

Indent-A list of indents.

Distance-The distance from the starting point for the indent. This can be a numerical number or a percentage. A percentage can be used to space a given number of impressions per the vector of positioning line distance.

Spacing-The amount of space between each indent.

Offset- The distance perpendicular to the line.

Load-The load for the tester being used. The load is located on the microhardness tester's weight knob.

Est. Length-The estimated length of the indents.

Est. Hardness-The estimated hardness of the indents. The indent is drawn based on this amount.

Circle Radius-The radius boundary to maintain around each indent. This will place a circle around the diamond indent area so that ASTM standards can be maintained.

Dwell-The software reads the dwell time from the micohardness tester.

Objective-The objective being used.

8. Click OK to close the properties dialog box.

9. Click the Make Indents button to make the actual indents in the sample.

10. The actual indent is displayed with a box around it.
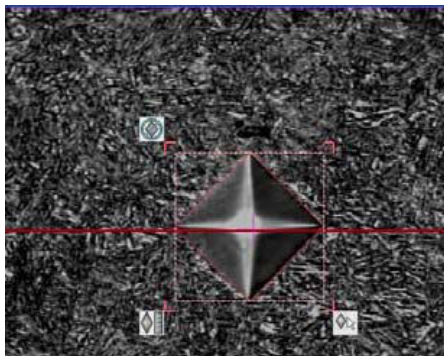
Linking Patterns

Several patterns can be linked so that they move as one. This saves time when analyzing the same type of samples.

1. Position the patterns on the sample. Refer to Positioning Patterns, page .

2. Click the Display Pattern Dependencies button.

3. An arrow is displayed on each pattern.

4. Click and drag the arrow to link it to another pattern. Repeat this for each pattern until all patterns are linked.
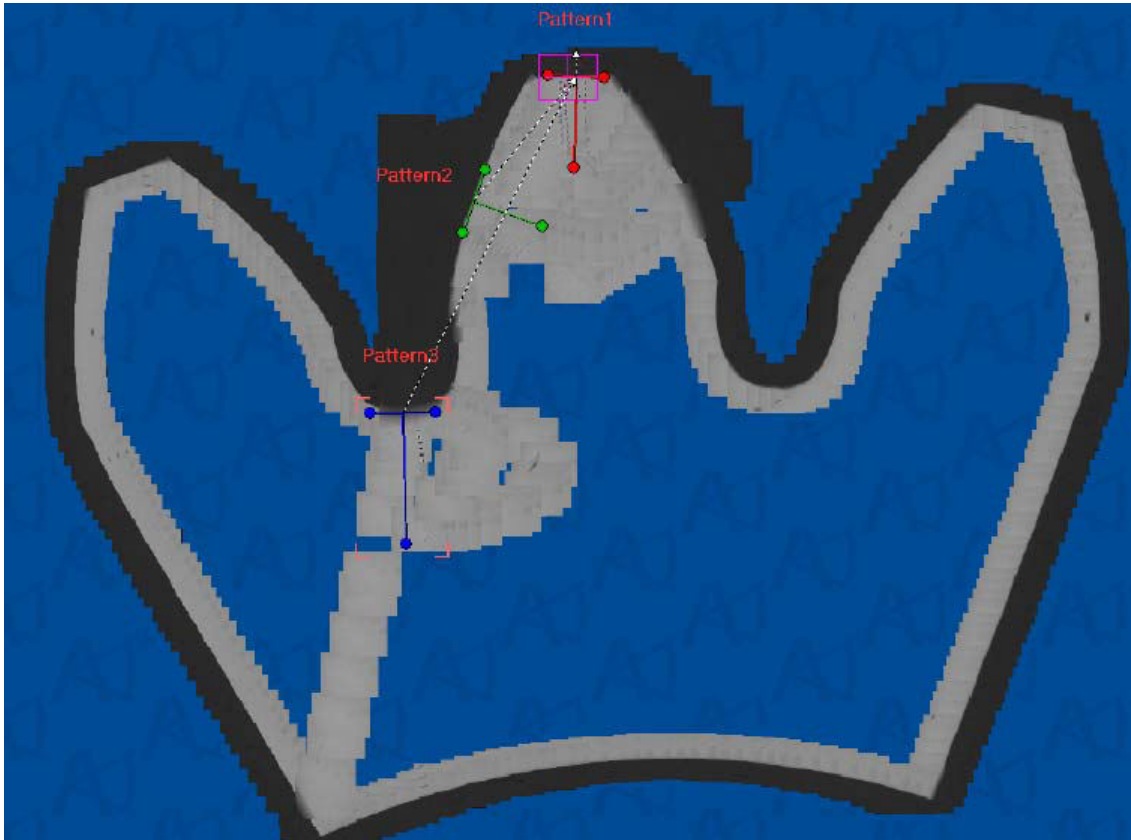
5. To save these linked patterns, click the Save Stage Pattern button and enter an appropriate name at the prompt.

6. After the linked patterns are saved, they can be reused at any time by clicking the Load Stage Pattern button and selecting the pattern from the list.

7. The following image shows the linked patterns before they are positioned on a new sample. To move them to a new image, click and drag one of the patterns to move all of the patterns to the correct position.
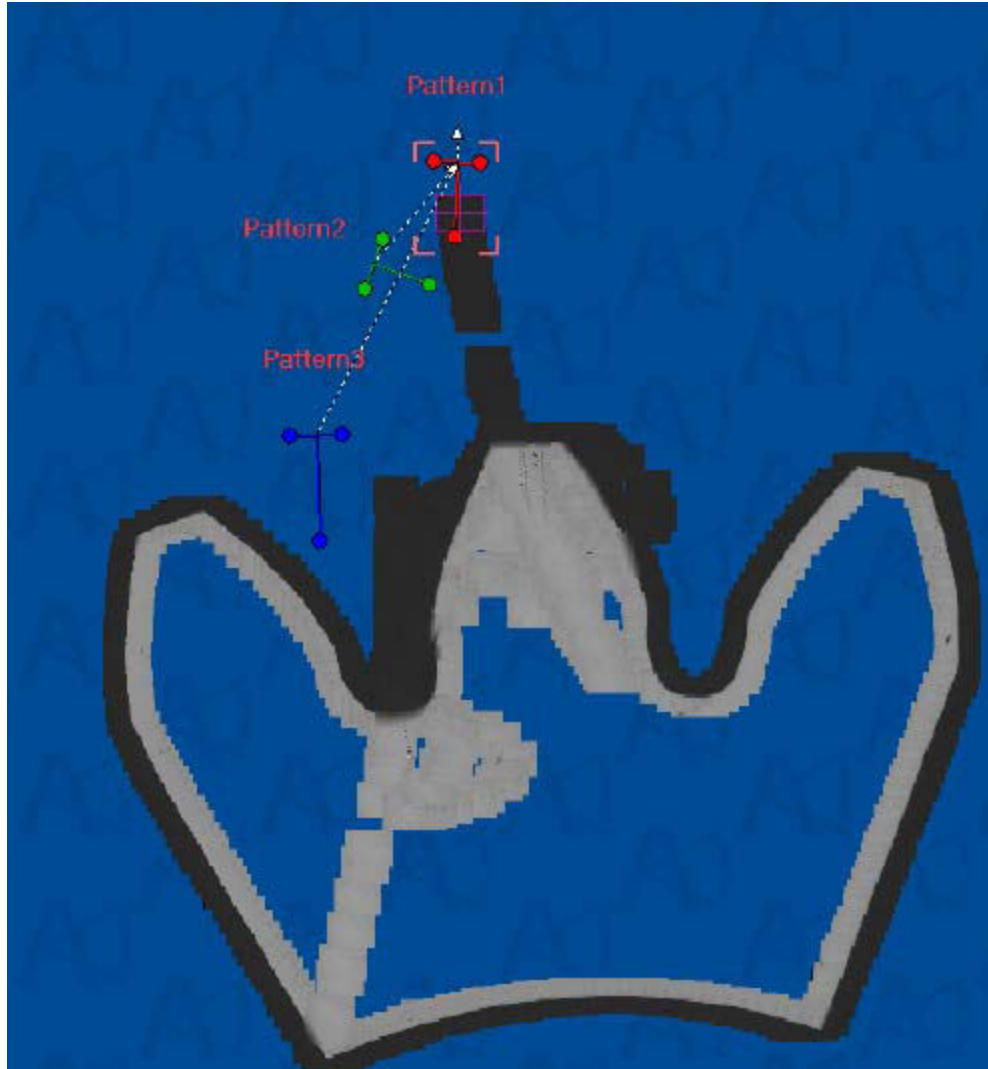
Manually Measure

1. Select the indent to be measured.

2. Resize and position the measuring box to fit the indent.
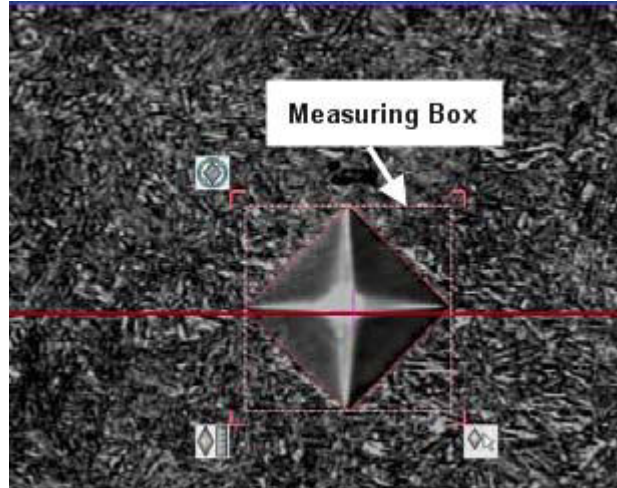
3. Click the Measure Indent button.

4. The stage moves to the indent and measures it.

Exporting Results

The AMH43 allows the option of saving analysis data to another file for use in other applications.

1. Select the samples to export from the Sample window.

2. Select Export from the toolbar to open the Export Sample dialog box.
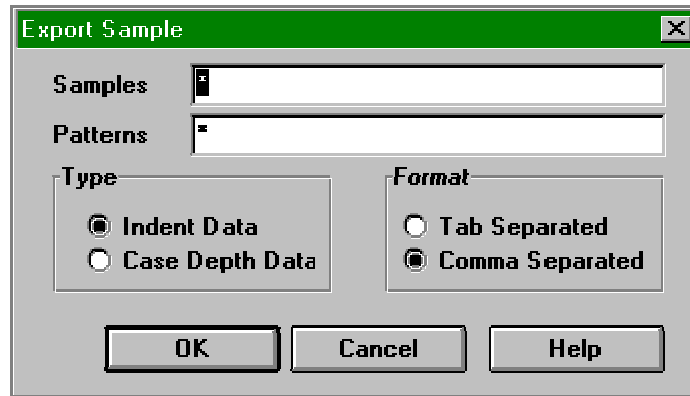
3. Enter the name of the sample to be exported in the samples field. To enter multiple samples use the search string characters from the following chart.

4. Enter the name of the patterns to be exported in the patterns field. To enter multiple samples use the search string characters from the following chart.

*	For example, **Pattern*** will include every pattern that begins with the word pattern.
?	For example, **Pattern?** will include every pattern the begins with the word pattern plus one character or letter (pattern1, but not pattern12).
[range]	For example, **Pattern[5-7 A-C]** will include pattern5, pattern6, and pattern7, patternA, patternB, patternC.

5. Select the type of data from the Type options.

6. Select the preferred format method to separate the files.

7. Click OK. The selected destination box is automatically displayed.

Select destination file

File name:
```
*.*
```

Folders:
c:\amh

📁 c:\
📁 amh

Save file as type:
All Files (*.*)

Drives:
💾 c:

OK
Cancel
Help
Network...
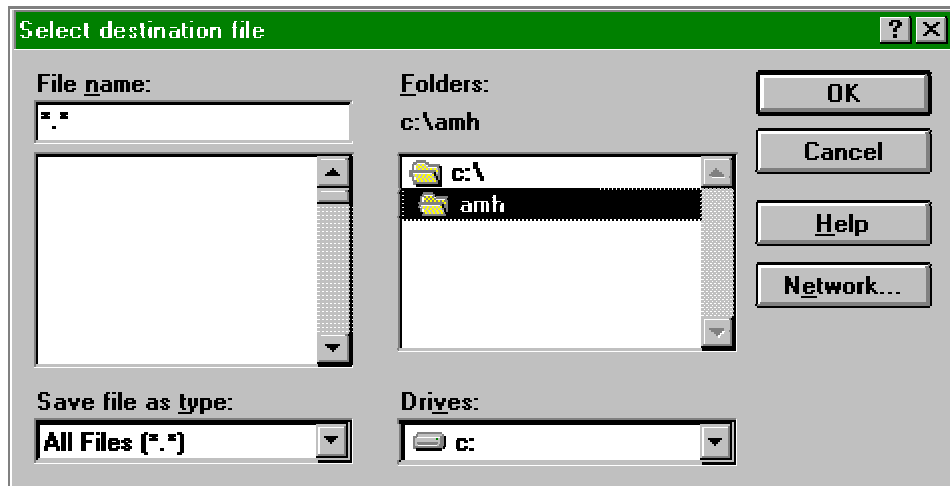
8. Enter the name of the file in which the data is to be stored in the File Name field.

9. Select the file type from the Save File As Type pull-down list.

10. Select the folder in which the data should be saved from the folder options.

11. Select the drive, from the Drives pull-down list, on which the file is to be stored.

12. If necessary, click the Network button to access the Map Network Drive dialog box and change the network mapping.

Reporting Results

After the hardness value and indent results are calculated, a report can be created and modified to fit your needs.

Creating a Report

The Report window displays the report layout. To open the Report Window, click and drag the Report from the Configuration Tree.

The Report layout and content can be created by using the Report Menu commands. Bitmaps, charts, tables, text, and Indent Images can be added to the report contents.
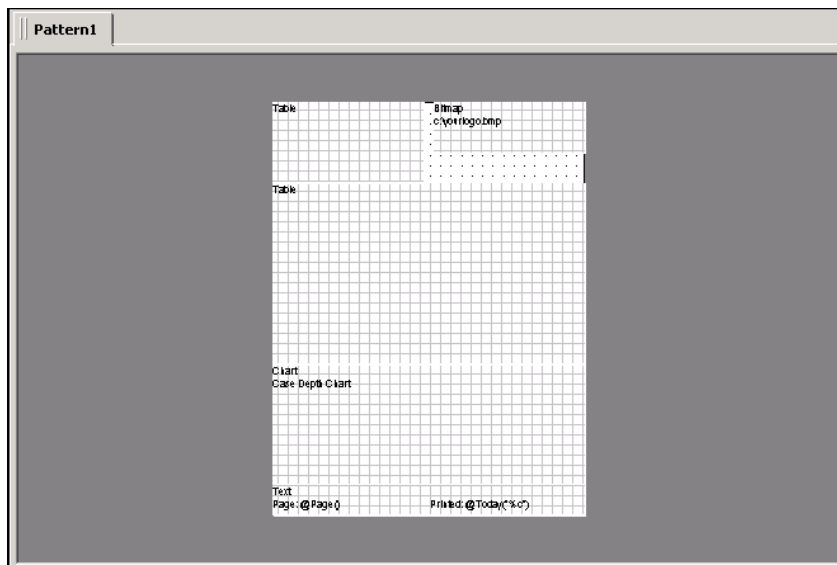
The Report pane allows for analysis data to be arranged in an organized format. The report elements can be resized by dragging a corner of the element frame. Clicking on a report element displays the element, as it would be printed. Double-clicking on a report element accesses the dialog box used to configure the data included in the report element.

Choosing the Print command from the Report Menu will access the options available for printing the report.

Adding Report Items

1. To add bitmaps, charts, indent images, tables, and text, click the Report Menu and then, click the item you want to include.

2. Click on the report to add the item to the report.

Selecting the Bitmap Image

1. From the Report, double-click the Bitmap to open the Bitmap dialog box.
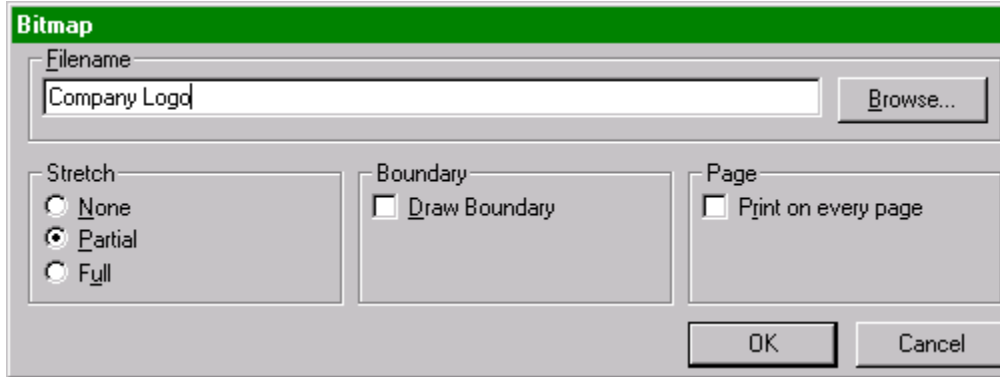
2. Enter the name for the bitmap file in the filename field or click the browse button to select it from available bitmap files.

3. Select the Stretch Type from the list.
   None-the image is not stretched.
   Partial-maintains the aspect ratio within the frame size.
   Full-fills the frame without regard to keeping the aspect ratio.

4. Check the Draw boundary checkbox to have a border drawn around the bitmap image.

5. Check the Print on Every Page to have the logo on all pages or leave unchecked to print it on just the first page.

Selecting the Chart

1. From the Report, double-click the Chart to open the Chart dialog box.

Chart

Chart
Case Depth Chart ▼

Page
☑ Print on every page

OK   Cancel
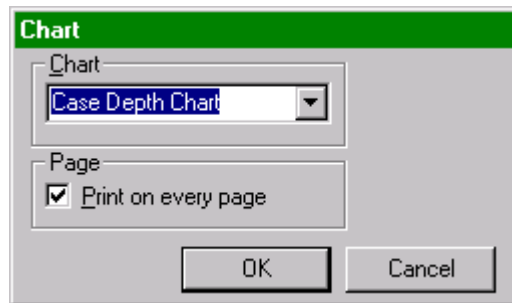
2. Select the Chart to include on the report from the dropdown list.

3. Select the Print on every page checkbox to include the chart on each page of the report.

Selecting the Indent Image

1. From the Report, double-click the Image to open the Image dialog box.

Image

Image
○ Main
○ Auxiliary
○ Sample
○ Field
◉ Mosaic of fields

▼

Page
☐ Print on every page

OK   Cancel
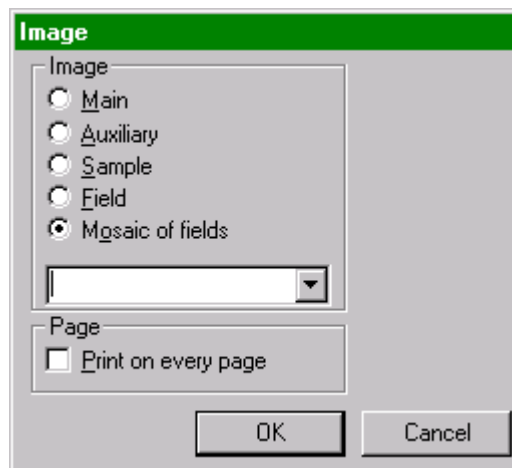
2. Select the Image type by clicking on the corresponding radio button in the Image list.

3. Select the Image from the dropdown list.

4. Select the Print on every page checkbox to include the image on each page of the report.

Selecting the Table

1. From the Report menu, double-click the Table to open the Table dialog box.
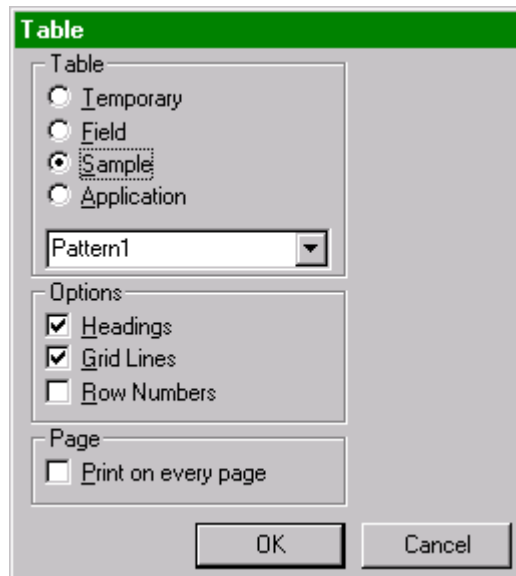
2. Select the Table's Configuration Tree location by clicking the radio button.

3. Select the Table's name from the dropdown list.

4. Select the Options by clicking the corresponding checkbox.

   Headings-Includes the headings on the table.

   Grid Lines-Includes the grid lines on the table.

   Row Numbers-Includes row numbers on the table.

5. Select to Print on every page by clicking the corresponding checkbox.

Composing the Text

1. From the Report, double-click the Text to open the Text dialog box.
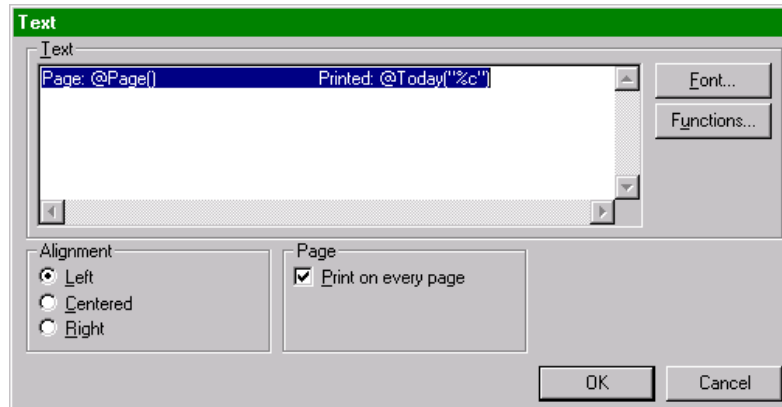
2. Select the alignment of the text from the Alignment by clicking the corresponding radio button.

3. Enter the desired text into the text area.

4. Click the Font button to select a font style, type, and size.

5. Click the Function button to access a list of functions that can be added to calculate expressions using the sample result data. The available functions are described on page 4−38.

Functions/ Formulas

The following functions can be placed in any formula edit box.

If you are creating a mathematical expression, precede the entire formula with an equals sign.

For example: "=@Minimum(10,13) * 7.3 / @Pi()"

@Abs(exp)

Returns the absolute value of the expression.

@ACos(value)

Returns, in radians, the arccosine of the value.

@AnalysisDate("date format")

Returns the date the sample was analyzed. For "date format", the most common setting is "%c".

@And(cond1, cond2)

Returns TRUE if both cond1 and cond2 evaluate to TRUE. Otherwise, returns FALSE.

@ApplicationTableAverage("table",column)

Returns the average of the values in the column specified by table and column. Column may be numeric or the column name enclosed in quotes.

@ApplicationTableCell("table", row, column)

Returns the contents of the cell specified by table, row and column. Table must be enclosed in quotes and refers to a table in the current sample. Row is numeric. Column may be numeric or the column name enclosed in quotes.

@ApplicationTableCount("table",column)

Returns the number of data rows in the column specified by table and column. Column may be numeric or the column name enclosed in quotes.

@ApplicationTableMax("table",column)

Returns the maximum of the values in the column specified by table and column. Column may be numeric or the column name enclosed in quotes.

@ApplicationTableMin("table",column)

Returns the minimum of the values in the column specified by table and column. Column may be numeric or the column name enclosed in quotes.

@ApplicationTableRsd("table",column)

Returns the relative standard deviation of the values in the column specified by table and column. Column may be numeric or the column name enclosed in quotes.

@ApplicationTableStatsCell("table", row, column)

Returns the contents of the cell specified by table, row and column. Table must be enclosed in quotes and refers to a table in the current sample. Row is numeric and starts with the first row of statistics. Column may be numeric or the column name enclosed in quotes.

@ApplicationTableStDev("table",column)

Returns the standard deviation of the values in the column specified by table and column. Column may be numeric or the column name enclosed in quotes.

@ApplicationTableSum("table",column)

Returns the sum of the values in the column specified by table and column. Column may be numeric or the column name enclosed in quotes.

@AreaSurveyed()

Returns the area surveyed by the sample.

@ASin(value)

Returns, in radians, the arcsine of the value.

@AspectRatio()

Returns the aspect ratio of the image in Main.

@ATan(value)

Returns, in radians, the arctangent of the value.

@Average(column)

Returns the average of the values in the column specified by column. Column may be numeric or the column name enclosed in quotes.

@ButtonEnabled("Macro")

Returns 1 if the button is enabled. Returns 0 if the button is disabled.

@ButtonPushed("Macro")

Returns 1 if the button is pushed. Returns 0 if the button is not pushed.

@ButtonState("Macro")

Returns the state of the button. 1 is the first state, 2 is the second, and so on. This is only applicable to macros with one or more state instructions. Otherwise, this function returns 0.

@ButtonVisible("Macro")

Returns 1 if the button is visible. Returns 0 if the button is visible.

@Calculate(exp, "Format")

Calculates the given expression and displays it using the specified format.

@Calibration( )

Returns the calibration of the image in Main.

@Cell(row,column)

Returns the contents of the cell specified by row and column. Row is numeric. Column may be numeric or the column name enclosed in quotes.

@Char(code)

Returns a character defined by the ASCII code.

@CircleCenterX(X1,Y1,X2,Y2,X3,Y3)

Returns the x-coordinate of the center-point of a circle. The circle is defined by three arbitrary points on its edge.

@CircleCenterY(X1,Y1,X2,Y2,X3,Y3)

Returns the y-coordinate of the center-point of a circle. The circle is defined by three arbitrary points on its edge.

@Column(column)

Returns the contents of the cell in the current row specified by column. Column may be numeric or the column name enclosed in quotes.

@Columns( )

Returns the number of columns.

@Comments( )

Returns the sample comments.

@Cos(radians)

Returns the cosine of the angle provided in radians.

@Count(column)

Returns the number of data rows in the column specified by column. Column may be numeric or the column name enclosed in quotes.

@Date( )

Displays the current date.

@Degrees(radians)

Returns, in degrees, the angle provided in radians.

@Description( )

Returns the sample description.

@Field( )

Returns the current field number, starting at one.

@FieldArea()

Returns the field area of the image in Main.

@Fields()

Returns the number of fields.

@If(cond, true, false)

If cond evaluates to TRUE, returns the value or string of the second parameter. Otherwise, returns the value or string of the third parameter.

@IsKeyPressed(virtkeycode)

Returns 1 if the virtual key code is pressed. Otherwise 0.

@Ln(exp)

Returns the natural logarithm of the given expression.

@Log10(exp)

Returns the base 10 logarithm of the given expression.

@Lookup(value,"table",column)

Returns the value of the cell specified by table, value, and column. Row is determined by the first row in table where column one does not exceed value. Column may be numeric or the column name enclosed in quotes.

@Max(column)

Returns the maximum of the values in the column specified by column. Column may be numeric or the column name enclosed in quotes.

@Maximum(value1,value2)

Returns the maximum of value1 and value2.

@Min(column)

Returns the minimum of the values in the column specified by column. Column may be numeric or the column name enclosed in quotes.

@Minimum(value1,value2)

Returns the minimum of value1 and value2.

@Name()

Returns the sample name.

@Operator()

Returns the operator's name that ran the sample.

@Or(cond1, cond2)

Returns TRUE if cond1 evaluates to TRUE, or if cond1 evaluates to TRUE, or if they both evaluate to TRUE. Otherwise, returns FALSE.

@Page()

Displays the page being viewed or printed.

@Pi( )

Returns the value of pi (a circle's circumference divided by its diameter).

@Radians(degrees)

Returns, in radians, the angle provided in degrees.

@RecalculatedDate("date format")

Returns the date the sample was last recalculated. For "date format", the most common setting is "%c".

@Row( )

Returns the current row number.

@Rows( )

Returns the number of rows.

@RowType( )

Returns the current row type. 1=Measurement, 2=Statistics, 3=Direct Line, 4=Direct Circle, 5=Direct Length.

@Rsd(column)

Returns the relative standard deviation of the values in the column specified by column. Column may be numeric or the column name enclosed in quotes.

@SampleTableAverage("table",column)

Returns the average of the values in the column specified by table and column. Column may be numeric or the column name enclosed in quotes.

@SampleTableCell("table", row, column)

Returns the contents of the cell specified by table, row and column. Table must be enclosed in quotes and refers to a table in the current sample. Row is numeric. Column may be numeric or the column name enclosed in quotes.

@SampleTableCount("table",column)

Returns the number of data rows in the column specified by table and column. Column may be numeric or the column name enclosed in quotes.

@SampleTableMax("table",column)

Returns the maximum of the values in the column specified by table and column. Column may be numeric or the column name enclosed in quotes.

@SampleTableMin("table",column)

Returns the minimum of the values in the column specified by table and column. Column may be numeric or the column name enclosed in quotes.

@SampleTableRsd("table",column)

Returns the relative standard deviation of the values in the column specified by table and column. Column may be numeric or the column name enclosed in quotes.

@SampleTableStatsCell("table", row, column)

Returns the contents of the cell specified by table, row and column. Table must be enclosed in quotes and refers to a table in the current sample. Row is numeric and starts with the first row of statistics. Column may be numeric or the column name enclosed in quotes.

@SampleTableStDev("table",column)

Returns the standard deviation of the values in the column specified by table and column. Column may be numeric or the column name enclosed in quotes.

@SampleTableSum("table",column)

Returns the sum of the values in the column specified by table and column. Column may be numeric or the column name enclosed in quotes.

@SigFigs(exp, "Format")

Converts the given expression to the specified number of significant figures.

@Sin(radians)

Returns the sin of the angle provided in radians.

@SqRt(exp)

Returns the square root of the given expression.

@StageX()

Returns the current X position of the stage.

@StageY()

Returns the current Y position of the stage.

@StageZ()

Returns the current Z position of the stage.

@StatsCell(row, column)

Returns the contents of the cell specified by row and column. Row is numeric and starts with the first row of statistics. Column may be numeric or the column name enclosed in quotes.

@StDev(column)

Returns the standard deviation of the values in the column specified by column. Column may be numeric or the column name enclosed in quotes.

@Sum(column)

Returns the sum of the values in the column specified by column. Column may be numeric or the column name enclosed in quotes.

@TableAverage("table",column)

Returns the average of the values in the column specified by table and column. Column may be numeric or the column name enclosed in quotes.

@TableCell("table", row, column)

Returns the contents of the cell specified by table, row and column. Table must be enclosed in quotes. Row is numeric. Column may be numeric or the column name enclosed in quotes.

@TableCount("table",column)

Returns the number of data rows in the column specified by table and column. Column may be numeric or the column name enclosed in quotes.

@TableMax("table",column)

Returns the maximum of the values in the column specified by table and column. Column may be numeric or the column name enclosed in quotes.

@TableMin("table",column)

Returns the minimum of the values in the column specified by table and column. Column may be numeric or the column name enclosed in quotes.

@TableRsd("table",column)

Returns the relative standard deviation of the values in the column specified by table and column. Column may be numeric or the column name enclosed in quotes.

@TableStatsCell("table", row, column)

Returns the contents of the cell specified by table, row and column. Table must be enclosed in quotes. Row is numeric and starts with the first row of statistics. Column may be numeric or the column name enclosed in quotes.

@TableStDev("table",column)

Returns the standard deviation of the values in the column specified by table and column. Column may be numeric or the column name enclosed in quotes.

@TableSum("table",column)

Returns the sum of the values in the column specified by table and column. Column may be numeric or the column name enclosed in quotes.

@Tan(radians)

Returns the tangent of the angle provided in radians.

@ThreePointAngle(CenterX,CenterY,AX,AY,BX,BY)

Returns the angle (counter-clockwise) from the line Center-A to the line Center-B in radians.

@Time()

Displays the current time.

@Today("date format")

Returns today's date. For "date format", the most common setting is "%c".

@XOr(cond1, cond2)

Exclusive Or operation. Returns TRUE if cond1 evaluates to TRUE and cond2 evaluates to FALSE, or if cond1 evaluates to FALSE and cond2 evaluates to TRUE. Otherwise, returns FALSE.

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5 Maintenance

Periodic Maintenance

The following guidelines will improve the length of service expected from the diamond indenter.

Take care to avoid shocks or bumps to the indenter and indenter shaft. Do not apply lateral force to the indenter or indenter shaft.

Keep the indenter tip clean. Indents made on a contaminated specimen or made with a contaminated indenter are difficult to measure accurately. Clean the indenter tip with a clean, unstarched, cotton cloth. If there is oil contamination, use a cloth dampened with benzene or a similar solvent.

Microscope

Illumination Lamp

When the light level is not uniform through the visual field, the illumination lamp may be tilted or misaligned Adjust the lamp by tuning the lamp screws until the illumination is maximized or uniform.

The visual field brightness is adjustable. Too much light may saturate the digitizer in the camera.

When replacing the illumination lamp, remove the entire lamp socket. Remove the bulb by turning it counter-clockwise while pressing down.

Use and Care

Microscope, Hardness Tester, and Camera

- *Always handle the microscope, hardness tester, and camera with care.*

- *Avoid exposure to direct sunlight, high temperature, and humidity, dust, and vibration. Dampness and dust are the most harmful conditions.*

- *Cover the microscope, harness tester, and camera when the unit is not in use.*

- *All glass surfaces in the unit must be kept clean.*

- *Fine dust on optical surfaces should be removed using a soft brush or bulb blower.*

- *Oil and fingerprints on the lens surfaces should be removed using gauze moistened with a small amount of alcohol mixed with ether (3:7). Be sure to turn the power off first.*

- *Do not use organic solutions to wipe any components other than the lenses.*

- *Plastic parts should be cleaned with a cloth dampened with a neutral detergent. Be sure to turn the power off first.*

- *Repairs or adjustments that require disassembling the unit should only be performed by professional technicians.*

Computer Monitors, Tower, Mouse, and Keyboard

- *Keep the unit components on a sturdy, level surface.*

- *Cover the monitors and keyboard when the unit is not in use.*

- *Use anti-static products to eliminate static charge build-up in the work area, and reduce the risk of electric shock.*

- *Remove dust from the monitor screen with a soft cloth.*

- *Clean the mouse roller ball according to manufacturer's guide.*

- *Plastic outer casings can be wiped clean with a cloth dampened with neutral detergent. Always turn the power off before cleaning.*

- *Repairs or adjustments that require disassembling system components can only be performed by professional technicians.*

Printer

- *Follow the manufacturer's guide for cartridge replacement procedures.*

- *Keep the printer on a sturdy, level surface.*

- *Plastic outer casings can be wiped clean with cloth dampened with a neutral detergent. Always turn the power off before cleaning.*

- *Repairs or adjustments that require disassembling system components can only be performed by professional technicians.*

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6 Theory of Operation

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AMH (Automatic Microindentation Hardness Testing)

The AMH (Automatic Microindentation Hardness Testing) combines the tasks of sample testing, measuring, converting, and documenting into one automated instrument operation. The operator just loads the sample, programs the indentation pattern, and initiates the test. Then the AMH makes the indentations, measures the marks, calculates, and then displays the results. The system is capable of Knoop or Vickers indentations on samples ranging from 10 gf to 1000 gf. AMH sample analyses are nonsubjective through the use of system controlled thresholding and measurements.

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7 Service

Illustrations

Indenter Replacement

Replacing indenters, or exchanging a Vickers indenter for a Knoop indenter is accomplished in the following manner.

To avoid damage to the indenter leaf spring, do **not** apply lateral forces on the indenter shaft.

Care should be exercised that no lateral force is applied when exchanging the indenter.

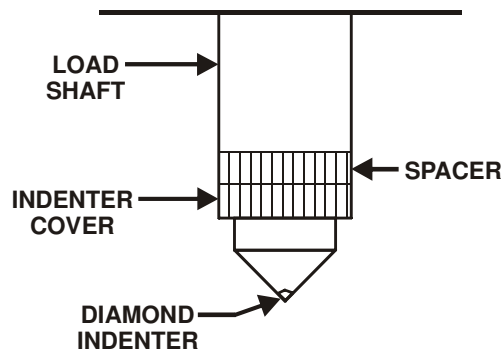1. Set the Load control Dial to 1000 gf.

2. Remove the indenter and spacer.

Figure 7-1
Indenter Cover and Spacer

3. After loosening the indenter collar setscrew, remove the indenter.

4. Install a new indenter with the red dot directly below the indenter collar setscrew. A Knoop indenter may need to be rotated 90° from the setscrew.
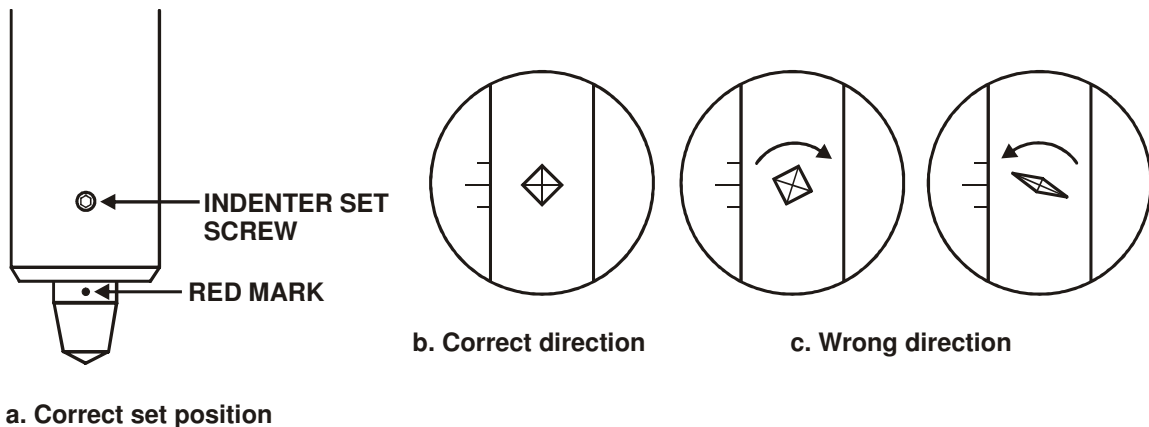

a. Correct set position

b. Correct direction

c. Wrong direction

Figure 7-2
Indenter Collar and Visual Field Adjustment Setscrew

5. While making sure the shoulder of the indenter is in contact with the indenter holder, tighten the indenter collar setscrew.

6. Make an indentation and check the symmetry of the indentation in the field of view. If the indentation is non-symmetrical, loosen the setscrew and slightly rotate the indenter. Repeat this step as necessary to obtain complete symmetry.

7. Reinstall indenter cover and spacer.

NOTE ▶ When indenters are replaced, or one type of indenter (Vickers of Knoop) is exchanged for another, alignment of the indentation to the reference point is required. Refer to the Positioning Indentation section, page 7–5.

Positioning the Indentation

1. Inset the test block into the stage and focus on the test block surface using the 10x objective.

2. Make one impression in a suitable area of the test block. Do **not** move stage after making impression.

3. If the indentation is not aligned to the reference line:

    A. Leave all knobs and the objective in place.

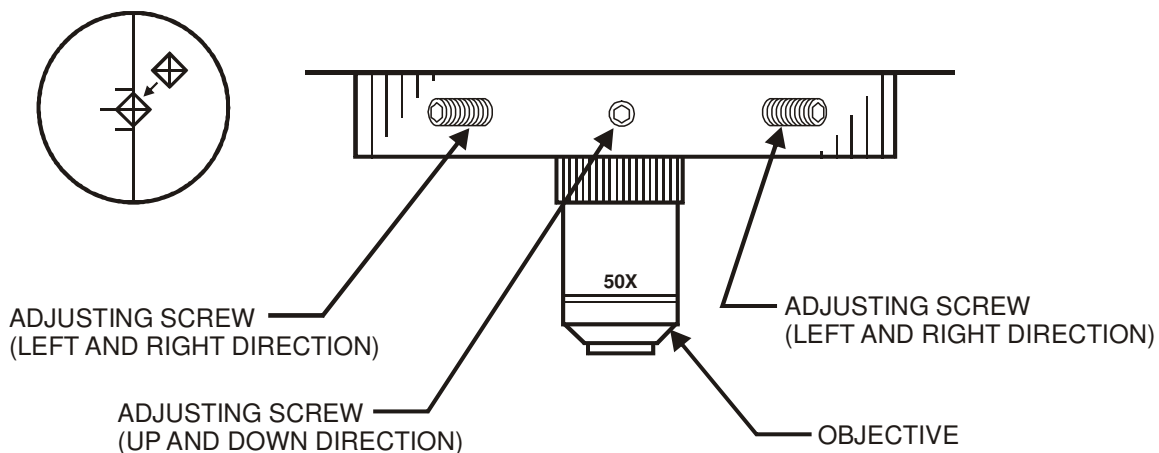   B. The Objectives move in a push/pull motion by alternate adjustment of the adjustment screw.

ADJUSTING SCREW
(LEFT AND RIGHT DIRECTION)

50X

ADJUSTING SCREW
(LEFT AND RIGHT DIRECTION)

ADJUSTING SCREW
(UP AND DOWN DIRECTION)

OBJECTIVE

Figure 7-3
Adjustment Screws

    C. By working the left and right Allen wrenches alternately, the indentation will be moved in a zigzag movement to the reference line.

    D. The center screw will move the indentation in the up and down direction.

        The objective is actually being centered to the indentation, not the indentation to the objective.

    E. Make sure that all three adjustment screws are snug when alignment is complete.

4. Repeat the preceding steps for the 50X objective.

    This procedure may need repeated several times to precisely bring the indentation into alignment for both objectives. Once this has been accomplished, the positioning of the indentation should remain constant.

Illumination Lamp

Adjustment

The illumination lamp should be adjusted to uniformly illuminate the visual field.

1. While observing the indention, turn the three pieces on the adjusting knob to adjust the lamp up and down until the lamp filament is centered in the field of view and the light is uniform within the visual fields.
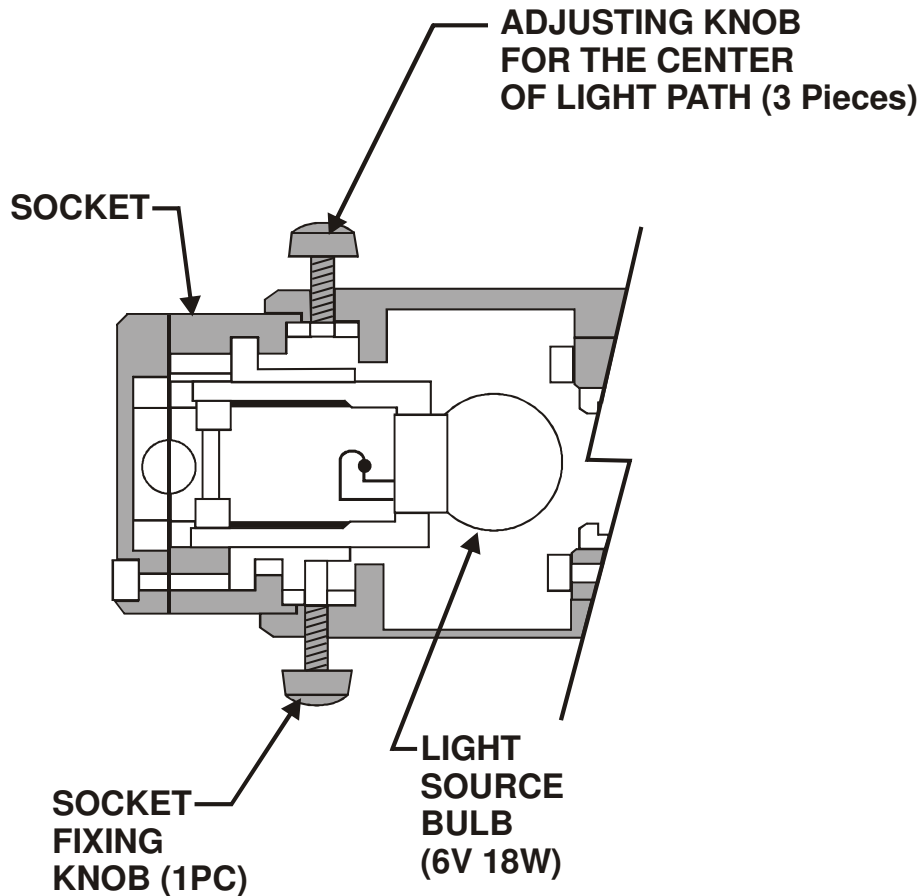
ADJUSTING KNOB FOR THE CENTER OF LIGHT PATH (3 Pieces)

SOCKET

SOCKET FIXING KNOB (1PC)

LIGHT SOURCE BULB (6V 18W)

**Figure 7-4
Illumination Lamp**

2. To adjust brightness of the visual field, turn the light intensity knob on the side or the micro-hardness tester.

NOTE ▶ Image brightness should be adjusted in accordance with the type of specimen. Too bright of field saturates the camera.

Replacement

1. Place the Power On/Off switch in the OFF position.

2. Remove the illumination lamp socket fixing screw.

3. Carefully remove the lamp socket.

4. Gently press in and turn the illumination lamp counterclockwise (CCW) to unlock the lamp from the socket.

5. Pull the lamp out and discard the lamp.

6. Insert a new lamp into the lamp socket, gently press in and turn the lamp clockwise (CW) to lock the lamp in the socket.

7. Reinstall the lamp socket and socket Fixing screw.

8. Place the Power On/Off switch in the ON position and check for uniform illumination within the field of view. If necessary, perform the illumination lamp adjustment procedure on page 7–6.

**ADJUSTING KNOB
FOR THE CENTER
OF LIGHT PATH (3 Pieces)**

SOCKET

**SOCKET
FIXING
KNOB (1PC)**

**LIGHT
SOURCE
BULB
(6V 18W)**
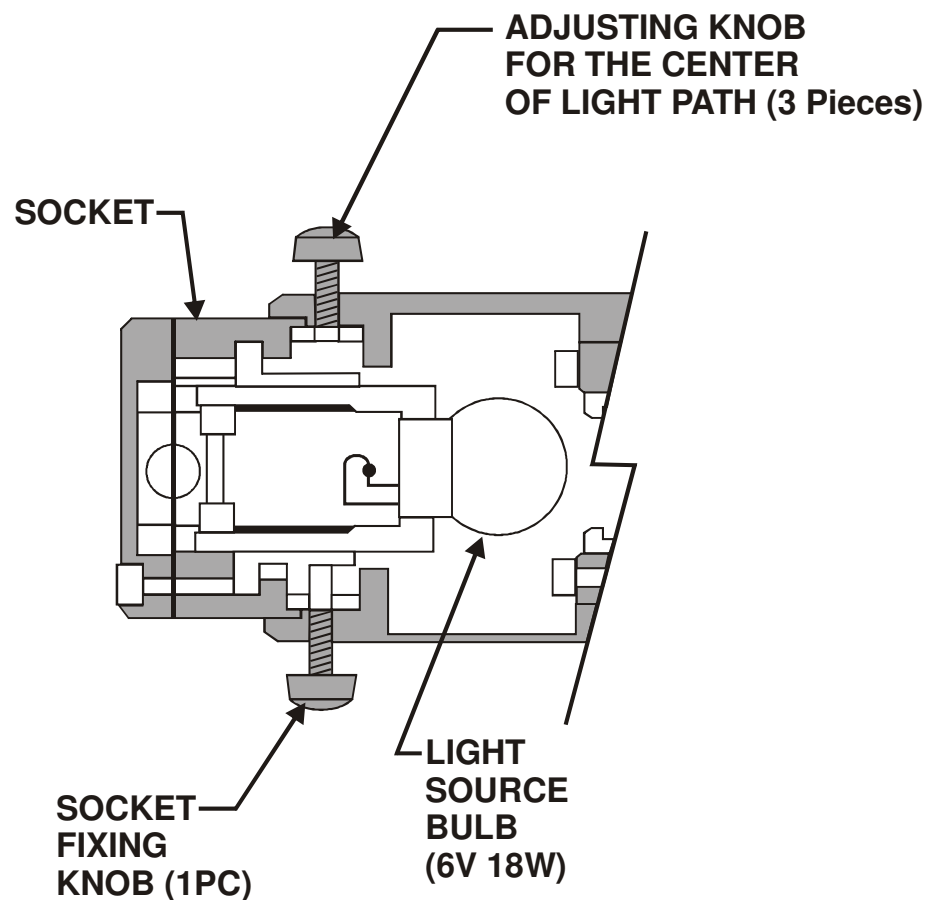
**Figure 7‑5
Lamp Location**

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8 Index

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