Maxim•GP
Operation Manual
OMP-0349G

Zygo Corporation
Laurel Brook Road
P.O. Box 448
Middlefield, Connecticut 06455-0448

Telephone: (860) 347-8506
Fax: (860) 346-4188
E-mail: inquire@zygo.com
Website: www.zygo.com

MANUAL REVISION INFORMATION - The document number and latest publication date for this manual appear on the title page. Any revision letter following the document number indicates that the manual has been revised and shows its current revision level. Appropriate revision letters also appear at the bottom of each revised page.

Manual revision status and printing history appear below.

Revision	Publication Date
Original	April 1994
Revision B	July 1994
Revision C	January 1995
Revision D	April 1995
Revision E	June 1995
Revision F	March 1996
Revision G	April 1996

NOTICE - The descriptions, drawings, and specifications contained herein are subject to change. Zygo is not responsible for errors or omissions herein or for incidental damages in connection with the furnishing or use of this information. This document shall not be reproduced, photocopied, or duplicated, in whole or in part, without prior written approval of Zygo Corporation.

Comments, discrepancies, or suggestions for this manual are appreciated and may be sent to the following address:

Zygo Corporation
Laurel Brook Road
P.O. Box 448
Middlefield, CT 06455-0448
Attention: Technical Publications Department
Or telephone (860) 347-8506

MANUAL NOTATIONS -

WARNING! Denotes a hazard that could cause injury to personnel and/or may cause severe damage to the equipment.

Note: Provides helpful information about the topic under discussion.

ZYGO STATEMENT OF WARRANTY AND PRODUCT SUPPORT

Zygo Corporation provides this warranty to protect its customers from defects in product workmanship or product materials. This warranty covers all products manufactured by Zygo Corporation. Zygo warrants that the equipment purchased will be free from any defects in material and/or workmanship under normal operating conditions for a period of one year from the date of shipment.

In addition, being committed to providing our customers with superior service, Zygo will support all standard products for a period of five years after the sale of the last newly-manufactured unit. Beyond this five-year period, we will continue to support these products on a "best-effort" basis.

WARRANTY SERVICE

Zygo's responsibility under this warranty shall be limited to the repair or replacement (at Zygo's option) of defective equipment at no cost to the buyer, except for transportation, cleaning, and recalibration charges.

Zygo will perform warranty service by: (1) sending replacement parts with appropriate installation instructions to the buyer, the buyer returning his defective part to Zygo or; (2) repairing the product at a Zygo repair facility after it has been returned freight prepaid, or; (3) at the buyer's request, dispatching a service representative to the buyer's facility. The buyer shall pay Zygo's travel and living expenses as well as travel time.

Defective products or parts will be repaired or replaced with new or like-new parts. These replacement parts will be warranted for a period of 90 days after they are shipped, or for the remainder of the original warranty period, whichever is longer. Warranty service will be performed only if the buyer notifies Zygo within 14 days of discovering any defects. Equipment or parts that are to be returned to Zygo must be issued a Return Authorization number. This number can be obtained by contacting the Zygo Service Department. Should Zygo's subsequent inspection reveal that the parts were not defective, all expenses incurred by Zygo shall be charged back to the buyer. Defective equipment that is replaced shall become the property of Zygo.

Warranty period begins when the product is shipped from Zygo. Replacement parts, service workmanship, used equipment, and refurbished equipment are warranted for a period of 90 days.

RETURNS

Unused and undamaged products, in their original shipping containers, may be returned for credit within 30 days of receipt. All such products will be subject to a restocking fee equal to 20 percent of the purchase price. Custom products are not returnable.

EXCLUSIONS

The above warranty and product support statement applies only to equipment that is an integral part of a Zygo manufactured product. It does not apply to peripheral equipment manufactured by others, such as: computers, printers, vibration isolation tables, etc. In such cases, the warranty and the support that the original manufacturer supplies will apply.

In addition, warranty service does not include or apply to any product or part which, in Zygo's judgment:

a. Has been repaired by others, improperly installed, altered, modified, or damaged in any way.
b. Malfunctions because the customer has failed to perform maintenance, calibration checks or good operating procedures.
c. Is expendable or consumable (such as lamp bulbs, panel lights, fuses, batteries, windows, and filters) if such items were operable at the time of initial use.
d. Requires replacement because of decomposition due to chemical action.
e. Fails because of poor facility, operating conditions, or utilities.

Other than expressly described above, Zygo makes no express or implied warranties, including any regarding merchantability or fitness for a particular purpose relating to the use or performance of the equipment. Zygo will not be liable for personal injury or property damage (unless caused solely by its own negligence), loss of profit or other incidental or consequential damages arising out of the use or inability to use the equipment. Nor does this warranty apply to any equipment which has been subject to misuse, neglect or accident; or repaired or altered by other than service representatives qualified by Zygo.

01/96

CONTENTS

CONTENTS

Chapter 1
THE MAXIM•GP SYSTEM

In This Chapter

- The Maxim•GP System
  - How the Maxim•GP Works
- System Processor Components
- Microscope Components
- Specifications
- Safety

THE MAXIM•GP SYSTEM

The Zygo Maxim•GP[1] is a general purpose surface profiler that measures the micro structure and topography of surfaces in three dimensions, using computerized phase-measuring interferometry. The Maxim•GP can measure a wide variety of surfaces: ultra polished surfaces, machined surfaces, films, read/write sliders, semiconductor wafers, ceramics, and more.

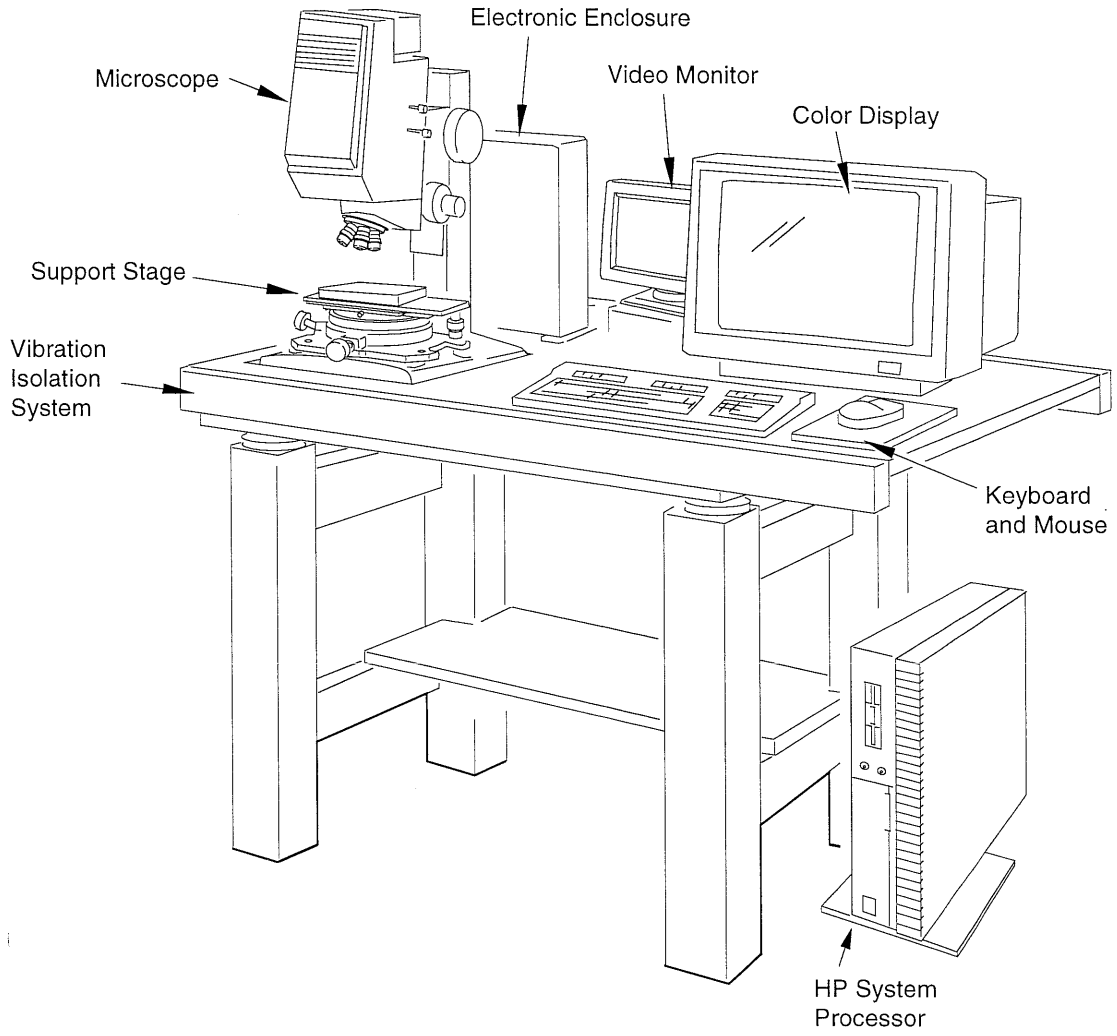
There are three major parts to the Maxim•GP system: the Microscope, the System Processor, and MetroPro™ software. Figure 1-1 shows the Maxim•GP system.

The Microscope combines optical microscopy and interferometry to provide the raw data needed for surface structure analysis. It includes the Microscope, objectives, Support Stage, Video Monitor, Electronic Enclosure, and a vibration isolation system. The microscope image zoom option, which provides variable zoom from 0.5 to 2.0 times the magnification of the objective in use, is described in Appendix B.

The System Processor controls the measurement process, performs calculations, and displays measurement results on a color monitor. It includes a computer, color display, mouse, keyboard, and a hardware key.

---

(1) U.S. and other patents pending.



Maxim•GP System

Figure 1-1

Zygo MetroPro software provides a unique, windowing, graphics interface with enough flexibility to satisfy data intensive research and development institutions, and easy of use and quickness for high throughput production lines. MetroPro analyzes areas as well as profiles, and provides numerous roughness results. Additional software options provide specialized testing capabilities.

The Maxim•GP is designed to be easy to use, even by an operator without computer or microscope experience. Focusing on a test part is guided by a real-time display of the surface and optical focus aids. The adjustable Support Stage simplifies aligning the test part. Measurements are made by pressing keys on the keyboard.

Unique features of the Maxim•GP are its two wavelength capability and turret mounted objectives. Two wavelength capability expands the vertical measurement range of the instrument up to 100 times over single wavelength interferometry, allowing a greater variety of surfaces to be tested. The turret accommodates up to five objectives for quick and easy magnification changes.

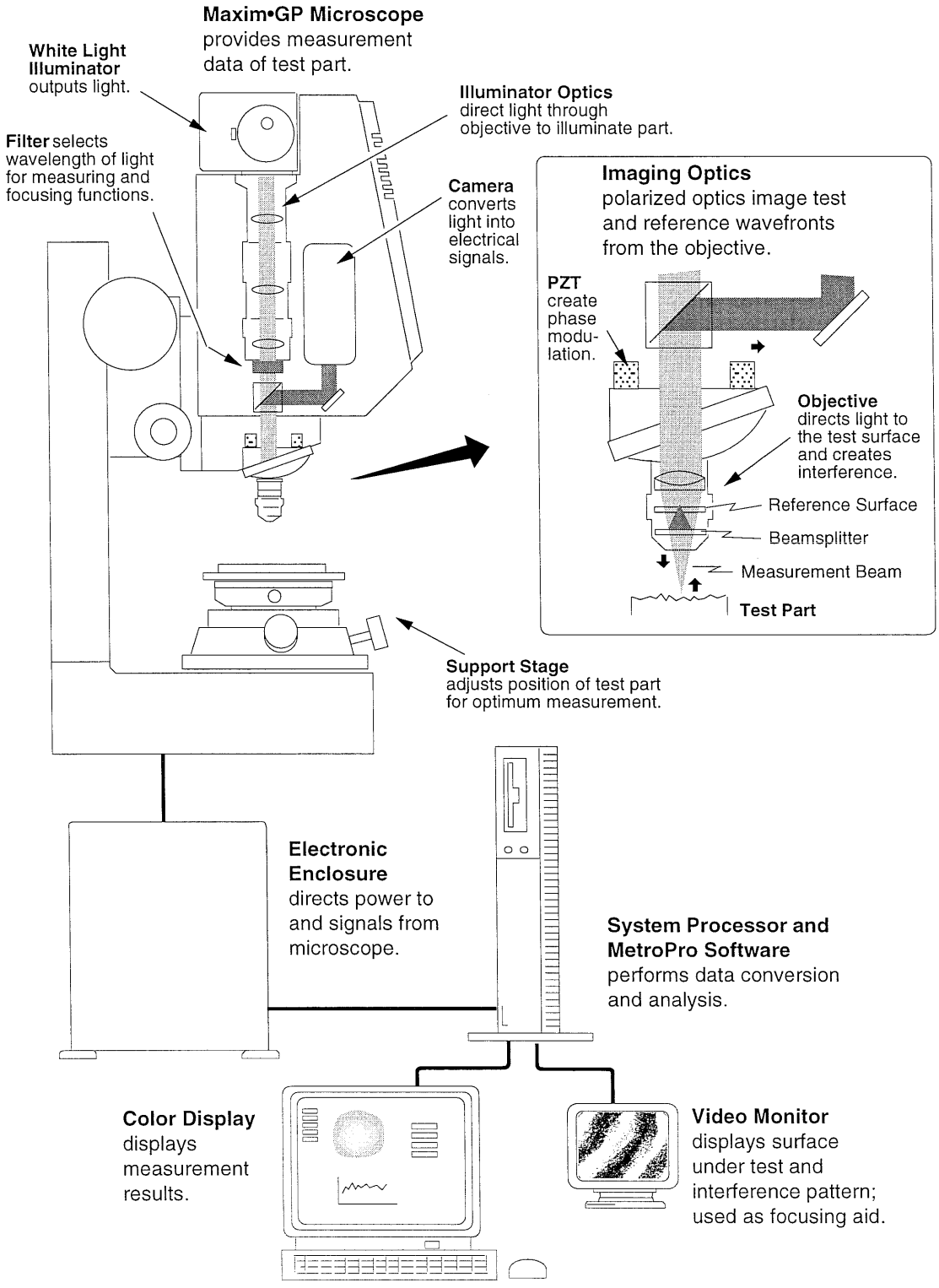
How the Maxim•GP Works

The Maxim•GP measures without contact, using filtered white light interferometry. Refer to Figure 1-2. The light source in the Microscope provides illumination of the part being measured. After passing through a narrow band filter and the objective, light from the Microscope divides; one portion reflects from the test surface and another portion reflects from an internal, high quality reference surface. Both portions are then directed onto a solid-state CCD camera.

Interference between the two wavefronts results in an image of light and dark bands (called fringes) which are one-half wavelength apart. These fringes are displayed on a video monitor, which magnifies the objective image 20 times. The phase difference between the two wavefronts is automatically quantified by precisely moving the reference surface with piezoelectric transducers (PZT's), and by sampling the solid state video camera pixels. The computer then analyzes the resulting signals.

Maxim•GP provides three dimensional surface information. Vertical measurements, normal to the surface, are performed interferometrically. Lateral measurements, in the plane of the surface, are performed by calculating the pixel size from the field of view of the objective in use. Results are displayed on a color display as graphic plots and precise numeric representations of the surface.

In two wavelength measurements, besides the primary optical filter, a second wavelength filter is used, creating a longer "synthetic wavelength". Single wavelength measurements are limited to step heights of about 0.16 micrometers. Two wavelength measurements extend that range to 2.5 micrometers, or with an optional filter set, to 10 micrometers.



How the Maxim•GP Works

Figure 1-2

SYSTEM PROCESSOR COMPONENTS

An HP 715 System Processor, controls the Microscope, runs the Zygo MetroPro software program, performs calculations, and displays the measurement results on a color display. Figure 1-3 shows the System Processor components and their function.

Note:

For more information on any of the Hewlett-Packard components, refer to the HP documentation.

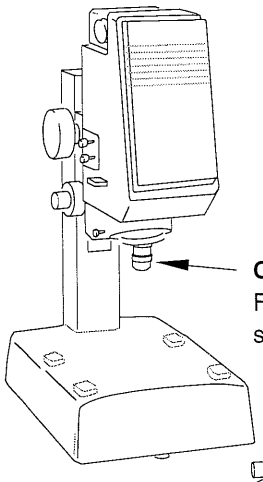
MICROSCOPE COMPONENTS

See Figures 1-4 and 1-5 for a breakdown of the Microscope components and their functions. For more detailed information on individual Microscope components, refer to the specification sheets, later in this chapter.

SPECIFICATIONS

The pages after Figure 1-5 provide greater details on the Microscope components.

Specifications appear in the order listed below.

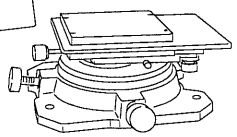


Maxim•GP Microscope
Provides measurement data of surface under test. It is a phase measuring interferometric microscope that supplies 3-dimensional analysis of the test part surface. It has manual coarse, medium, and fine focusing knobs. It connects to the Electronic Enclosure.

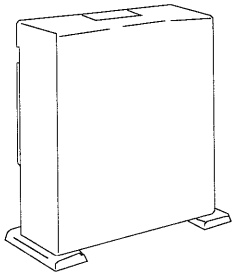
Objective
Forms an image of the test surface. (See next page.)

Filter Sets	λ1	λ2	Max Step
Standard	620 nm	650 nm	2.5 µm
Optional	633 nm	640 nm	10 µm

(λ1 and λ2 are typical values)

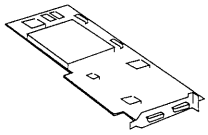


Support Stage
Holds the part under test and provides for tip, tilt, and X and Y positioning. It attaches to the Microscope base and accepts top plates.

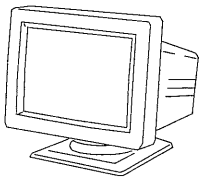


Electronic Enclosure
Houses the main instrument board and power supply. Provides power to the Microscope and interfaces to the HP System Processor.

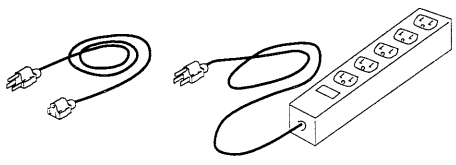
Note: Items not drawn to scale.



Matrox Board
Controls all aspects of data acquisition. It is installed in the HP System Processor and connects to the Electronic Enclosure and Video Monitor.



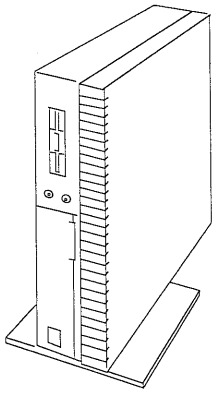
Video Monitor
The 9-inch diagonal monochrome screen displays a live image of the part under view 20 times larger than the viewing area of the objective. It is used for part focusing and displaying results. A monitor stand with an objective holder is included.



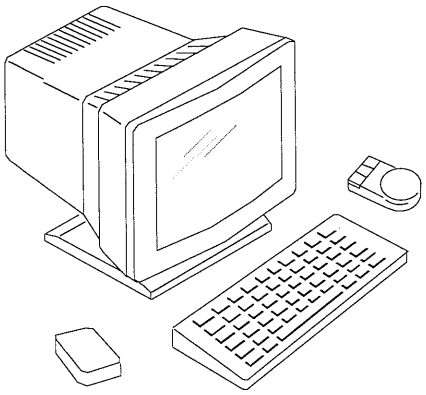
Power Kit
Includes an outlet strip and power cords to connect the system to incoming power. Versions available for 100, 120, 220, and 240 VAC line voltage.

Microscope Components (page 1 of 2)
Figure 1-4

Documentation for all components on this page is provided by HP.



System Processor
HP Model 715 Computer
For system control and data storage; houses the Matrox Board. Includes: an internal SCSI hard drive, 3.5-inch floppy drive, and 32 MB of RAM.
Extra RAM and ThinLAN Ethernet Transceiver optional.

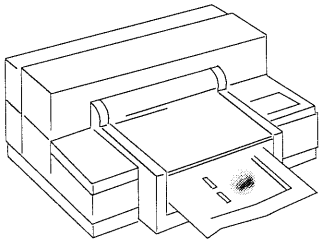


HP Color Display
Displays graphics and data. Two versions: 15-inch with 1024 x 768 pixel resolution and 19-inch with 1280 x 1024 resolution.

HP Mouse
Used for program control and selecting menus.

HP Keyboard
Used for data entry.

HP ID Module
Hardware key necessary to enable MetroPro and software options.

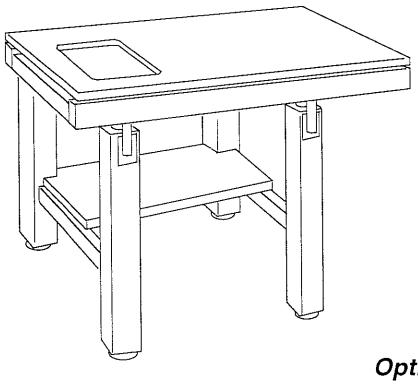


Option
HP DeskJet Printer
Outputs color copies of MetroPro Screens. Connects directly to the computer.

Note: Items not drawn to scale.

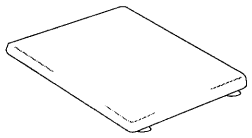
System Processor Components
Figure 1-3

Vibration Isolation Systems
Isolate the Microscope from environmental vibrations that degrade measurements.



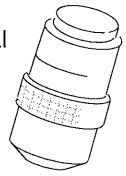
Vibration Isolation Table
The Microscope sits on a rigid laminated table top floating on self-leveling air pistons. Some components sit on a large upper shelf, which is isolated from the table. The table requires a 60 psi source of compressed air or bottled nitrogen. It is 35 x 45 x 34 in. (HWD).

The table is manufactured by Technical Manufacturing Corporation (TMC). Operating instructions are provided by TMC.



Option
Table-top Vibration Isolator
Holds the Microscope and provides vibration protection in lieu of the table. It should sit on a rigid platform and not on the same surface as the other components.

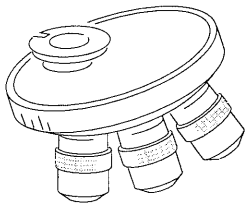
Option
Interferometric Objectives



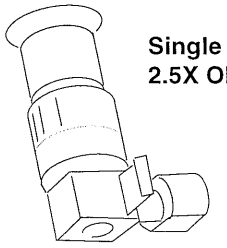
Gathers light from the test object and forms a real image of it. The objective creates interference by dividing the light into two paths; directing one to an internal reference surface and the other to the test surface. Due to test surface irregularities, the test or measurement wavefront travels different distances. When the reference and measurement wavefronts are recombined, the waves are out of phase and form an interference pattern.

Objective	Type	System Magnification
2.5x	Michelson	50x
5x	Michelson	100x
10x	Mirau	200x
20x	Mirau	400x
40x	Mirau	800x
100x	Mirau	2000x

Additional specifications are provided on page 1-10.

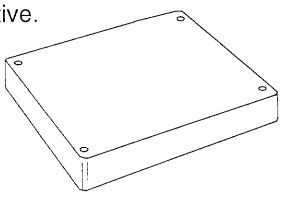


Turret Mount
Holds up to 5 objectives and provides for quick magnification changes. Slides into the Microscope. Will not accommodate the 2.5X objective.

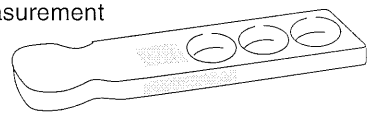


Single Mount
2.5X Objective

Option
Top Plates
Attaches to the top of the Support Stage to locate parts or fixtures under the objective.



Option
10 μm Step Filter Set
Provides 10 micrometer step height measurement capability.

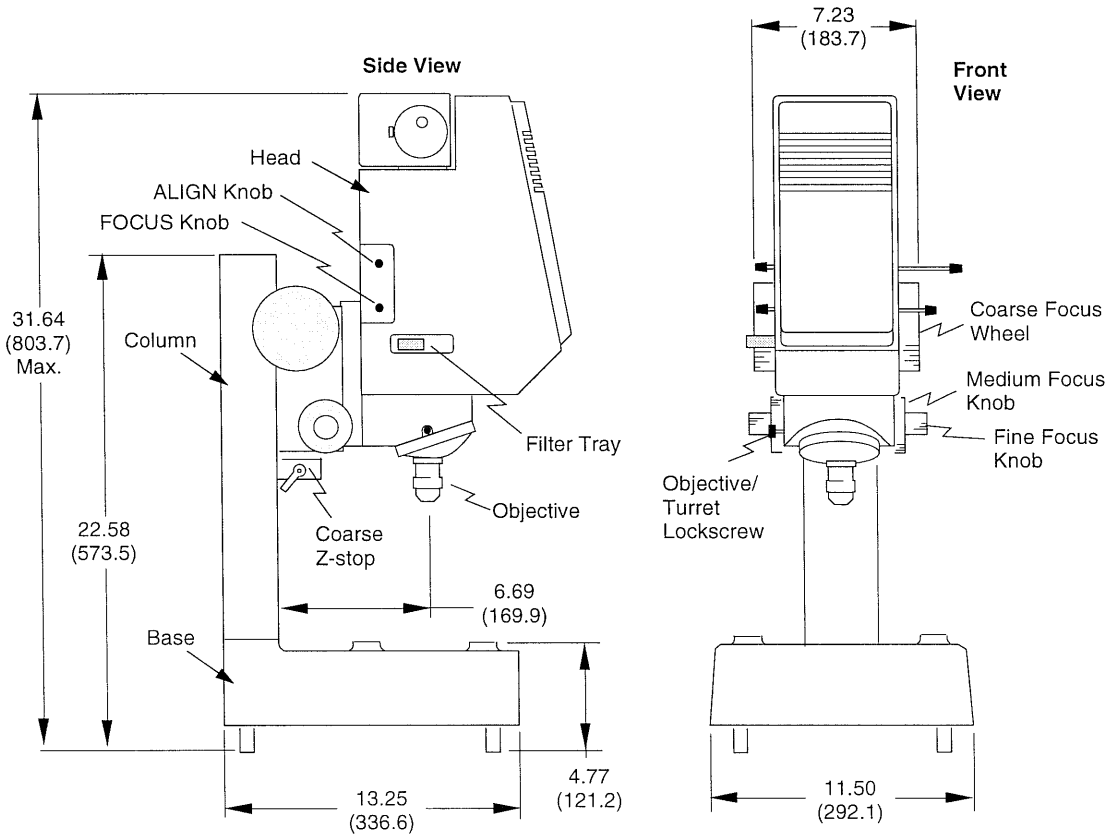


Microscope Components (page 2 of 2)
Figure 1-5

Zygo
Maxim•GP Microscope

Physical Characteristics:
Dimensions: See Figure.
Weight: 80.5 lb (36.5 kg)
Measurement Technique:
Phase shifting interferometry.
Light Source: Filtered white light
Part Viewing: Real-time Video Monitor
Focus Control:
Coarse Wheel - 22 mm/turn, with tension adjust
Medium Knob - 4.7 mm/turn, with tension adjust
Fine Knob - 0.2 mm/turn
Vertical Travel: 5.1 in. (130 mm)
Objective Mounting: Standard Nikon turret dovetail, single dovetail mount and turret mount
Camera Size: 640 x 480 pixels

Electrical:
Incoming Power from Electronic Enclosure
Operating Environment:
Temperature: 15° to 30°C (59° to 86° F)
Rate of Temperature Change: <1.0°C/15 minutes
Humidity: 5 to 95% relative, noncondensing
Vibration: Frequency Isolation - 1Hz < freq < 120Hz
Performance:
Lateral Resolution:
0.46 to 4.87 µm (objective dependent)
Maximum Vertical Step Height:
~0.1 µm (single wavelength, standard filter set)
2.5 µm (two wavelength, standard filter set)
10 µm (two wavelength, optional step filter set)



Dimensions are shown in inches and (millimeters)

Zygo
Interferometric Objectives

See Appendix B for image zoom specifications.

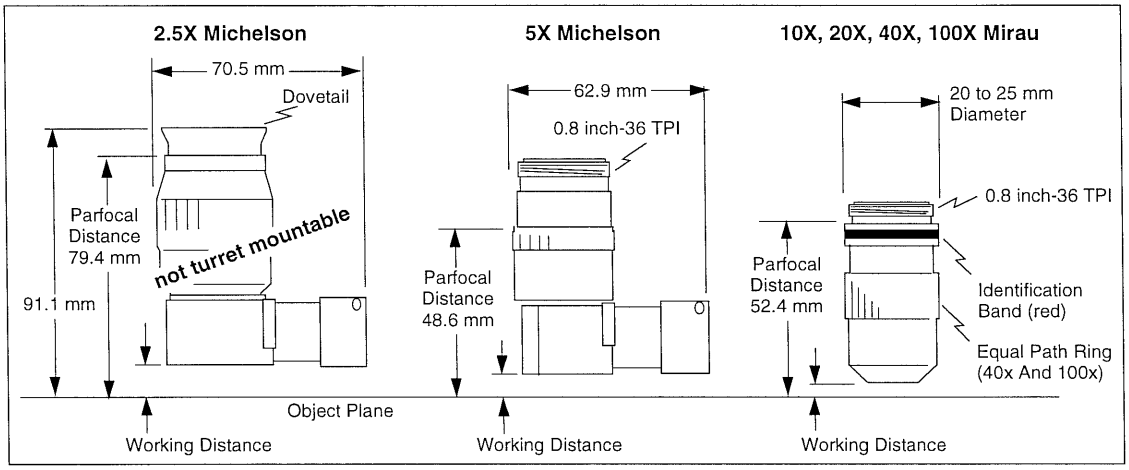
Physical Characteristics:
Typical Dimensions: See Figures in Box.

Type: 2.5X and 5X are Michelson objectives; 10X, 20X, 40X, and 100X are Mirau objectives. Coherence bandwidth centered within depth of focus. Useful for measuring the top surfaces of transparent and partially transparent materials, as well as curved and angled opaque surfaces with 4 to 100% reflectivity.

Magnification Range: 2.5X, 5X, 10X, 20X, 40X, 100X

Parfocal: 10X, 20X, 40X and 100X are parfocal.

Viewing Magnification on Video Monitor: 20 times the objective magnification.



Power	Sys Mag	NA	Working Distance	Focus Depth	Inter Depth	Lateral Res (µm)	Field of View H x V (mm)	Spatial Samp (µm) Lo	Spatial Samp (µm) Std	Slope (deg) Lo	Slope (deg) Std
2.5X	50X	0.075	11.1 mm	185 µm	40 µm	4.87	2.82 x 2.11	8.80	4.40	1.0	2.0
5X	100X	0.1	9.0 mm	70 µm	40 µm	3.65	1.41 x 1.06	4.40	2.20	2.0	4.1
10X	200X	0.25	4.0 mm	10 µm	20 µm	1.46	0.70 x 0.53	2.20	1.10	4.1	8.1
20X	400X	0.4	2.5 mm	3.5 µm	7.0 µm	0.91	0.35 x 0.26	1.10	0.55	8.1	15.9
40X	800X	0.5	4.5 mm	1.8 µm	3.6 µm	0.73	0.18 x 0.13	0.55	0.28	15.9	22.3
100X	2000X	0.8	0.6 mm	0.6 µm	1.2 µm	0.46	0.070 x 0.053	0.22	0.11	33.3	33.3

Objective Table Notes:

Power	Magnifying power of the objective.
Sys Mag	System magnification, the enlargement of the surface as viewed on the Video Monitor.
NA	Numerical aperture, a number representing the resolving power of the objective.
Working Distance	The distance from the end of the objective to the test surface when focused.
Focus Depth	Vertical distance within which any specimen detail will simultaneously be in focus.
Inter Depth	Interference depth, vertical distance over which interference can occur; based on 10 nm filter.
Lateral Res	Lateral resolution, optical resolution of the imaging system.
Field of View	The size of area imaged and measured.
Spatial Samp	Spatial sampling, the apparent pixel size at each magnification.
Slope	Maximum angle of surface feature from one pixel to the next that can be measured.
Lo Std	Camera size in pixels: Lo is 320 x 240 pixels, Std is 640 x 480 pixels

Zygo
Support Stage

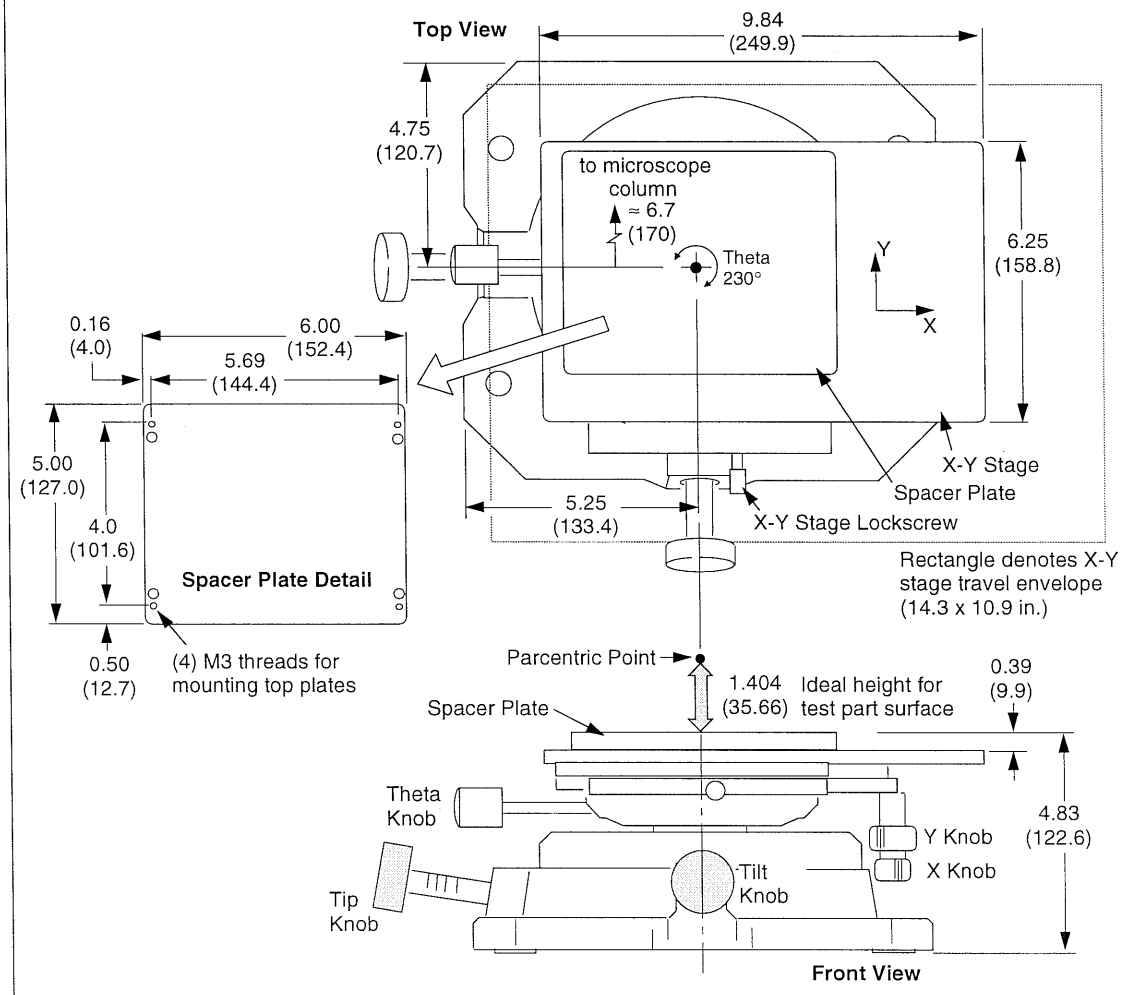
Physical Characteristics:
Dimensions: See below.
Weight: 19 lb (8.6 kg) without top plate

Controls:
Parcentric Tip and Tilt knobs - rotate the top of the stage about a point 1.8 in. above the stage.
X knob - linear motion side-to-side, coaxial with Y.
Y knob - linear motion front-to-back, coaxial with X.
Theta knob - rotate the top of the stage around its center (z-axis).

Adjustment Range:
Tip/Tilt: ±6 degrees
X and Y: ±2 in. (50 mm)
Theta: 230°

Sample Size:
Max. Thickness: 3.5 in. (89 mm)
Throat Depth: 6.7 in. (170 mm)

Top Plates (Optional):
Optimize the sample surface locations to the parcentric point.
General Purpose Top Plates:
0.012 in. to parcentric point (P/N 6300-0130-01)
0.372 in. to parcentric point (P/N 6300-0130-02)
0.722 in. to parcentric point (P/N 6300-0130-03)
Fluoroware™ Top Plates:
2 x 2 trays (P/N 6300-0151-01)
3 x 3-3/4 and 4 x 4 trays (P/N 6300-0151-02)



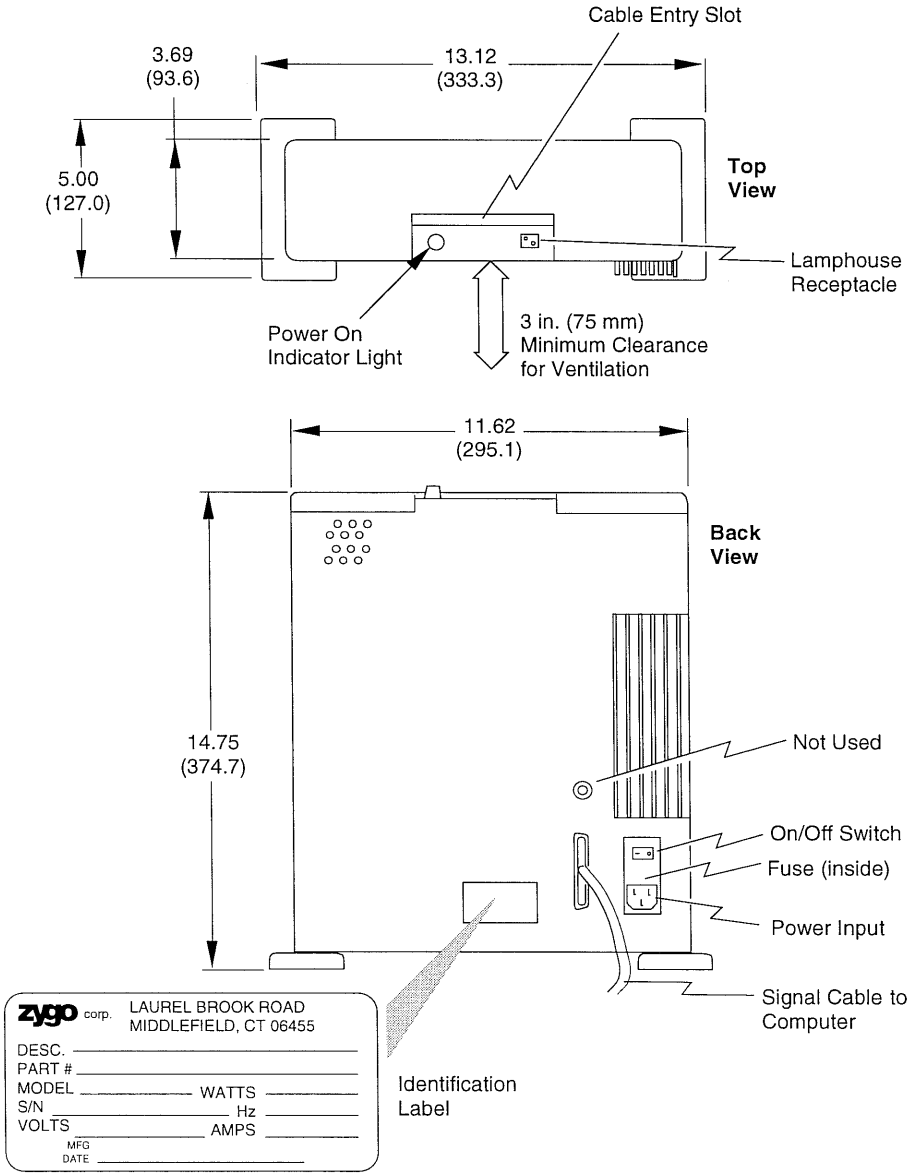
Dimensions are shown in inches and (millimeters)

Zygo
Electronic Enclosure

Physical Characteristics:
Dimensions: See Figure.
Weight: 3.9 lb (1.8 kg)

Electrical:
Incoming Power: 90 to 250 VAC, 50/60 Hz
Power Dissipation: 35 watts maximum
Fuse Rating (supply module): 250V 2A

Operating Environment:
Temperature: 15° to 30°C (59° to 86° F)
Humidity: 5 to 95% relative, noncondensing



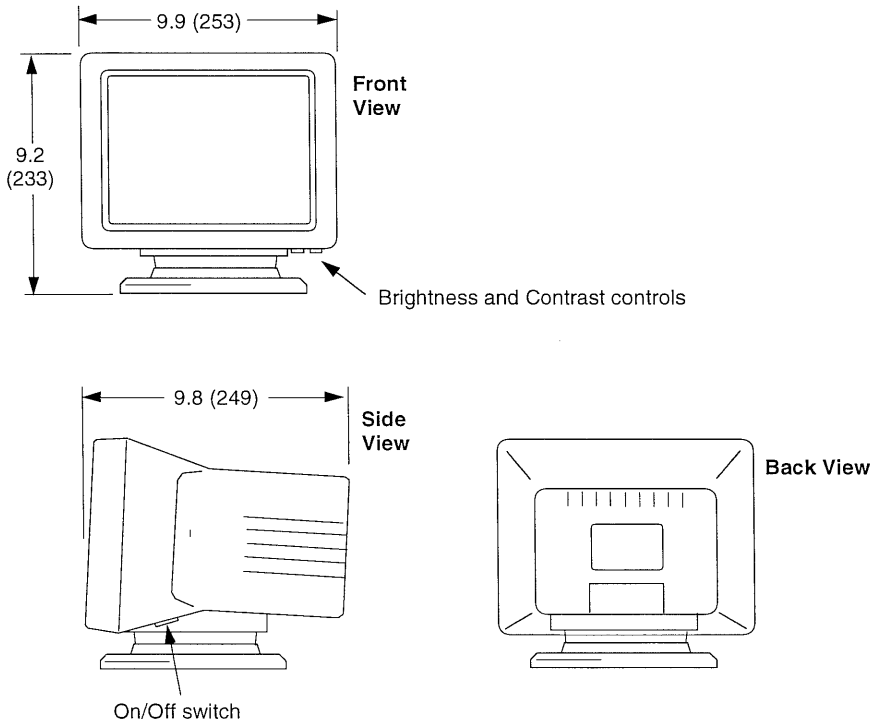
Dimensions are shown in inches and (millimeters)

Video Monitor

Physical Characteristics:
Dimensions: 9.2 x 9.9 x 9.8 in. (233 x 253 x 249 mm) (HWD)
Picture Tube: Monochrome 9-inch (23 cm) diagonal
Weight: 7.7 lb (3.5 kg)

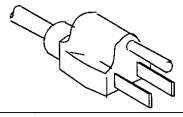
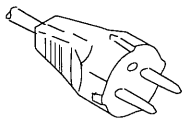
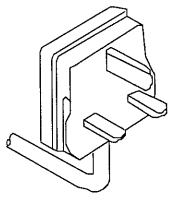
Power Requirements:
Voltage: universal 100 - 240 VAC
Line Frequency: 50/60 Hz
Power Consumption: 20 watts typical

Video:
Input Signal: RGB Analog
Connector: 15 pin D-sub cable
Resolution: 640 x 480 pixels



Dimensions are shown in inches and (millimeters)

Zygo
Power Kit

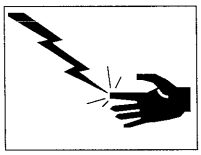
Plug Type	AC Voltage	Country	Zygo Part No.
	100V (1)	Japan	6300-0227-03
	120V	United States Canada	6300-0227-01
	220V	France Germany	6300-0227-02
	240V	United Kingdom	6300-0227-04

(1) Includes 3-prong to 2-prong plug adapters.

SAFETY

Failure to follow the safety recommendations in this manual could result in damage to the Maxim•GP System and may void the warranty.

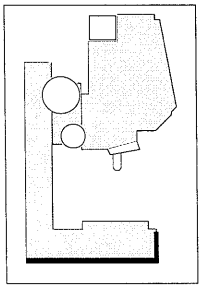
Electrical



WARNING!

- ❑ **Ensure that all power is off during installation and when connecting and disconnecting cables.**
- ❑ **The equipment must be electrically grounded through the outlet. The grounding lug for each component's plug should connect to ground.**
- ❑ **Be careful of electrostatic discharge (ESD) when handling and installing electronic components. A static control grounding wrist strap should be used when installing or handling the Matrox Board. Circuit boards should be stored in a static shield bag.**

Microscope



WARNING!

- ❑ **The Microscope weighs about 80 pounds (36 kilograms). Exercise care when moving or lifting the Microscope. To prevent back injury, bend your knees when lifting, and get help if you need it.**
- ❑ **Be careful when adjusting the Coarse Focus Wheel tension. If the tension is too loose the Microscope head can fall under its own weight.**
- ❑ **Be careful when focusing the Microscope; do not allow the objective to contact the test part or Support Stage. Use the Coarse Z-stop.**
- ❑ **Handle the objectives with care; they are precision devices. Do not touch any glass surfaces.**
- ❑ **Do not touch the lamp housing; during use the housing may be extremely hot and cause burns.**
- ❑ **When replacing the bulb, turn off power, wait for the bulb to cool, and do not touch the replacement bulb with bare hands.**

Chapter 2
INSTALLATION

In This Chapter

- A Note About Installation
- Preinstallation Considerations
- Installation Checklist
- Installation Procedures
  - 1. Install System Processor
  - 2. Mount Microscope Head
  - 3. Install Filter Tray
  - 4. Assemble Support Stage
  - 5. Position Components
  - 6. Connect Cables
  - 7. Connect Power
  - 8. Install MetroPro
  - 9. Align Lamb Bulb
  - 10. Install Turret or 2.5 Objective
  - 11. Mount Objectives on Turret
  - 12. Align Support Stage

A NOTE ABOUT INSTALLATION

This chapter describes important things that should be done before you set up your system and provides detailed installation instructions.

If you are performing your own installation, please first read over the entire chapter to get an overview of the process. Do not attempt to use the system until you are familiar with its operation.

Installation instructions for computer equipment and vibration isolation equipment are covered separately in documentation provided by the original manufacturers.

PREINSTALLATION CONSIDERATIONS

Before installing your metrology system, you should carefully consider the following aspects of the installation:

- Operating Environment
- Utility Availability

Operating Environment

Because the Maxim•GP system is capable of measuring to the sub-Angstrom level, the environment in which it is installed is significant and will have an affect on its overall performance. There are several aspects of the operating environment to be considered:

Vibration - The most significant environmental concern for the system, and the most difficult to control. Vibration can be introduced by any of several sources: floors with insufficient support or rigidity, acoustic noise, other equipment (fans, etc.), human activity, and so on.

Ideally, the floor of the installation site should be a poured concrete slab at ground level. This greatly reduces large-amplitude vibrations. Small amplitude vibrations transmitted through the ground, such as those caused by human activity, can be eliminated by using a vibration isolation system.

Acoustic vibration (sound) of sufficient amplitude can cause vibration of the Microscope, items under test, and even of the top of a vibration isolation table. This is especially true of low-frequency vibrations, which may not be audible even at relatively high amplitude. Uninsulated walls made with plasterboard are prone to retransmitting acoustic vibration from adjoining areas and suspended ceilings can couple roof mounted air conditioning noise.

Vibration can also be transmitted to the Microscope and support table through connecting cables. Be careful not to run cables where they would be touching sources of vibration or are likely to be jarred or kicked. Don't place the keyboard, mouse, or anything that has moving parts, on the vibration isolation table. Even equipment operating on a vibration isolation system's shelves may transmit vibration.

Zygo offers two different vibration isolation systems. Properly installed, they should minimize vibration effects.

Temperature - Rapid temperature changes will degrade system performance because different materials absorb and release heat at different rates, resulting in uneven expansion and contraction of the Microscope and components under test. The maximum acceptable rate of temperature change is approximately 1°C (1.8°F) per 15-minute interval.

Wide concurrent temperature differences in the operating environment can also degrade performance because they create air turbulence which can disturb the measurement beam. Such temperature differences can be caused by air conditioning and/or heating devices or vents.

Air Turbulence - Fans or blowers help to even out temperature differences in the operating area. However, if these are positioned improperly, they can cause air turbulence and vibration problems. Air turbulence causes uneven air density within small areas, thus refracting parts of the measurement beam and altering the wavefront.

Airborne Impurities - Smoke, dust, and grease or oil globules can accumulate on optical components, degrading their performance, and eventually ruining sensitive optical coatings.

Utility Availability

Electrical - Incoming voltage can be 100, 120, 220, or 240. The Maxim•GP system requires an isolated 15 amp (100/120 V) or 10 amp (220/240 V) power circuit with at least two separate outlets and an earth ground.

Air Supply - If used, the Vibration Isolation Table requires a compressed air supply or bottled nitrogen. Operation at maximum load requires a supply line pressure of approximately 75 PSI (5.3 kg/cm^2), although typical operation pressure is less. The flow rate is negligible once the isolator has been pressurized. The air supply should be filtered and oil and water free. Bottled nitrogen normally does not require filtering.

INSTALLATION CHECKLIST

A series of checklists are provided to assist you in installing your metrology system. Use the checklists as a summary of the installation procedure.

Note:

The steps covered in HP documentation, included with the HP components, are indicated by HP. Other steps are covered in later sections of this chapter.

Preinstallation

- ☐ Inspect all packages for signs of shipping damage. Report any damage to the carrier.
- ☐ Check that the shipment is complete.
- ☐ Ensure that the worksite has the necessary utilities and environmental control. *[pages 2-2 and 2-3]*
- ☐ If installation and training are included in your purchase, contact your Zygo representative to make arrangements.
- ☐ Move all shipping containers to the worksite. Allow the equipment to acclimate for at least 24 hours.
- ☐ Unpack the equipment from the shipping boxes and place it near its working location. *Do not unpack the Microscope yet.*

Note:

Save the shipping containers for possibke future use.

System Processor Installation ⚡ *Follow ESD precautions*

- HP If necessary, install the EISA Adapter Board, Matrox Board, floppy drive, and extra RAM in the HP System Processor. (Most systems come with these items factory installed.)
- HP Mount the floor stand to the System Processor and stand the unit vertically.

(continued)

Microscope Installation

- ☐ Carefully unpack and mount the Microscope head to the column.
- ☐ Position the Microscope on the vibration isolation system. Other components must be isolated from the Microscope.
- ☐ Install the Microscope filter tray.
- ☐ Assemble the Support Stage.
- ☐ Position the remainder of the system components.
- ☐ Connect the signal cables to the components.
- ☐ Position the power strip near the work table.
- ☐ Connect the components to incoming power.
- ☐ Install MetroPro software following the instructions in Chapter 3 of *Getting Started With MetroPro, OMP-0346.* Then start MetroPro and login.
- ☐ Align the lamp bulb.
- ☐ Install the turret and objectives. *Handle with care.*
- ☐ Align the Support Stage.

You are now ready to begin using your metrology system.

INSTALLATION PROCEDURES

There are 12 major procedures to install your Maxim•GP system. These procedures are listed in numerical order.

1. Install System Processor

Most of the HP System Processor components are simply unpacked, set in position, and then interconnected with cables. A cable interconnection diagram is located later in this chapter.

Most systems come with the Matrox Board and additional RAM factory installed. If it is necessary to install these items, refer to the procedures below. In all cases, you should install the Processor floor stand.

Note:
For more information, refer to the HP documentation:
HP Hardware Installation Guide Model 715, and
HP Model 715 Owner's Guide (Appendix B).

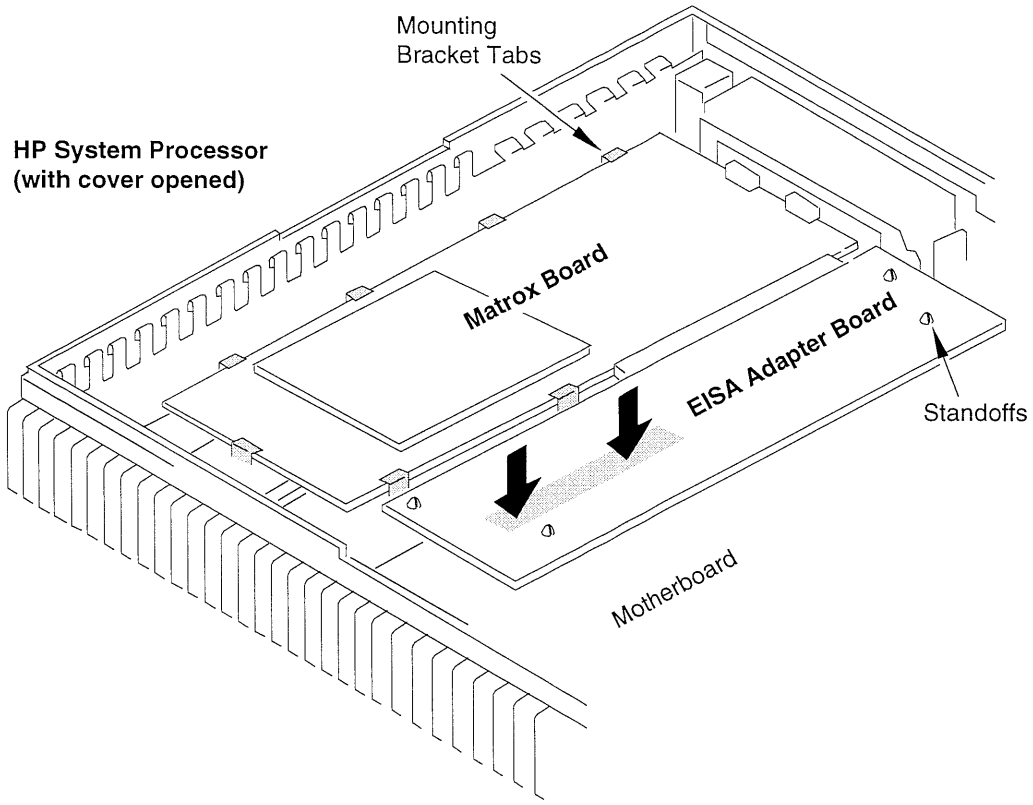
Install the Matrox Board

Most systems come with the Matrox Board factory installed. If it is necessary to install the board, follow the instructions below and refer to Figure 2-1.

1. Turn off power. Open the HP System Processor. Wear an ESD wrist strap to protect the electronics from electrostatic discharge. (If retrofitting an existing system, remove the Matrox Board, EISA Adapter Board, and the related hardware that held the Matrox Board. Slide the new Mounting Bracket in place.)
2. Attach the Matrox Board to the EISA Adapter Board.
3. Align the outside edge of the Matrox Board against the four outside bracket tabs. Align the EISA Adapter Board with the EISA socket on the Processor motherboard.
4. Position the assembly into place. The Matrox Board is secured by seven bracket tabs. The EISA Adapter Board is secured by four standoffs. Press firmly on the EISA Adapter Board at the arrows to ensure the board is fully seated.

Install the Additional RAM

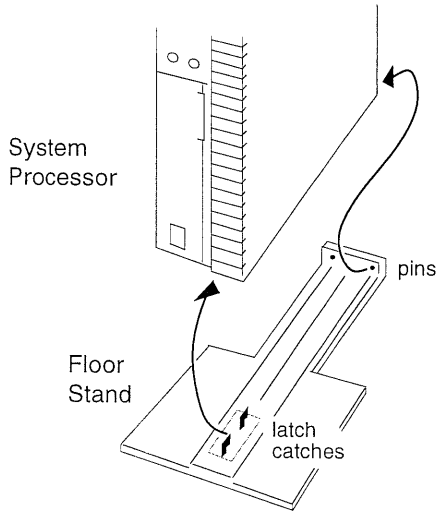
Most systems come with additional RAM factory installed. If it is necessary to install RAM follow the instructions provided in the HP documentation.



Matrox Board Installation
Figure 2-1

Install the Floor Stand

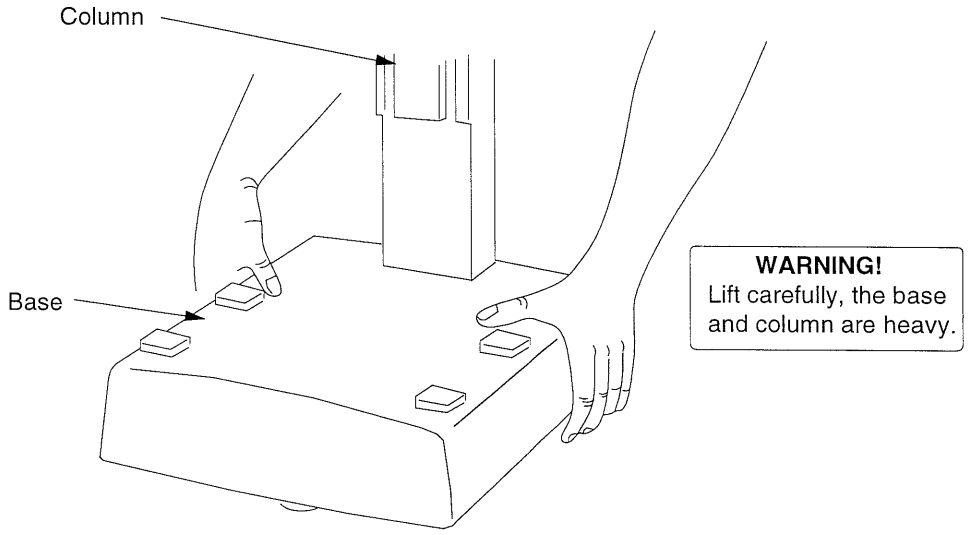
1. Insert the floor stand into the end of the unit as shown. Slide the latch on the bottom of the stand to lock it in place. For greater detail refer to the HP Hardware Installation Guide.
2. Stand the System Processor in a vertical position.



Installing the Floor Stand
Figure 2-2

2. Mount Microscope Head

Refer to Figure 2-3 for lifting the column. Refer to Figure 2-4 for mounting the Microscope head on the column.



Lifting the Column and Base
Figure 2-3

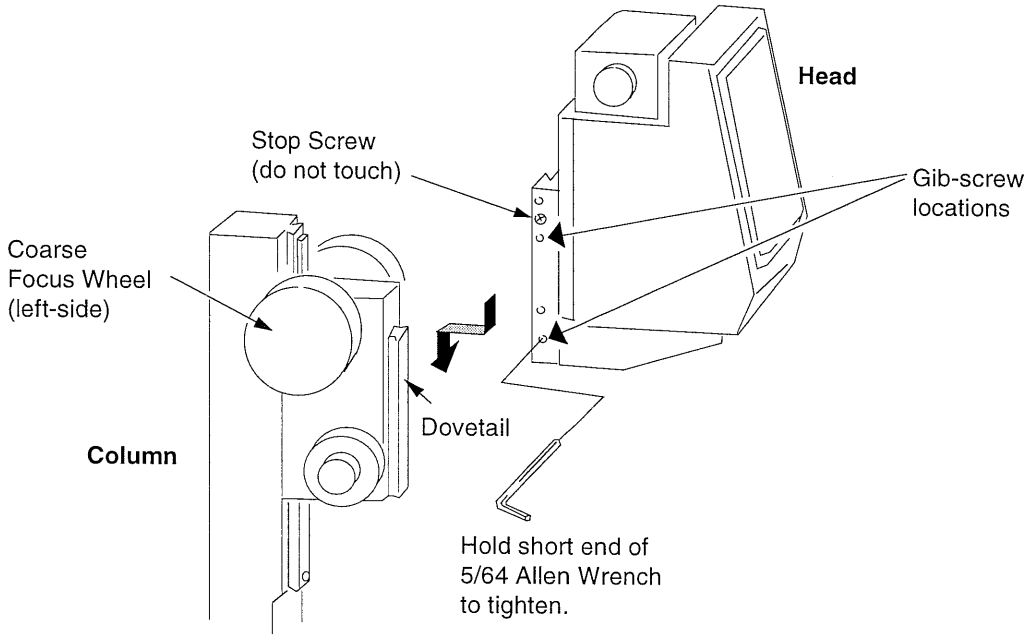
1. Remove the microscope column and base assembly from the shipping box. Lift the assembly as shown in Figure 2-3. Lift carefully; the column and base weigh about 65 pounds (30 kg). Stand it upright.
2. Remove the Microscope head from the shipping box, being careful not to touch it near the objective mount area.
3. Lift the head above the column and align the dovetail of the head with the dovetail on the column.
4. Lower the head completely on to the column until it stops.

5. Holding the short end of a 5/64-inch Allen wrench, hand-tighten the two gib-screws located on the head.

WARNING!

The Microscope head can drop under its own weight if the tension on the coarse focus wheel is not properly set.

6. If necessary, adjust the tension on the coarse focus wheel so the head doesn't drop under its own weight. To increase the tension, turn the right-hand wheel in the direction of the arrow on the wheel *while holding the left-hand wheel.*



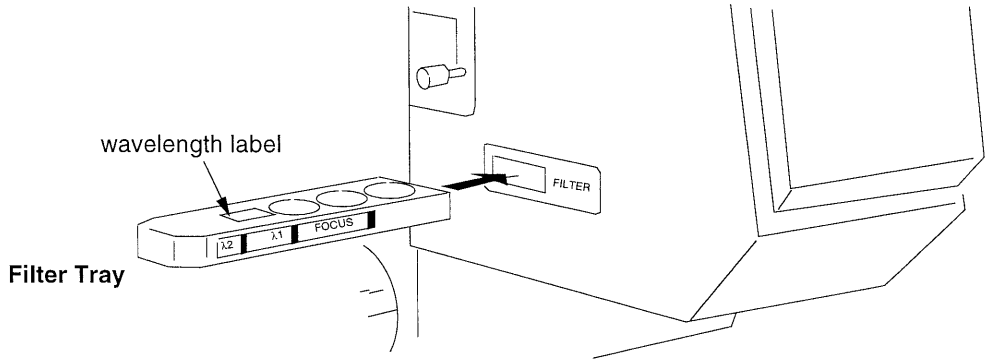
Mounting the Head on the Column

Figure 2-4

3. Install Filter Tray

The Filter Tray slides into the slot in the Microscope head; refer to Figure 2-5. Detents and a side label mark the stop locations for the focus and measure filters. Note that the wavelengths for λ1 and λ2 filters are indicated on a label on the top of the filter tray.

1. Unwrap the filter tray. Remove the protective tape from the side of the Microscope head covering the filter slot.
2. Slide the filter tray into the slot.



Installing the Filter Tray
Figure 2-5

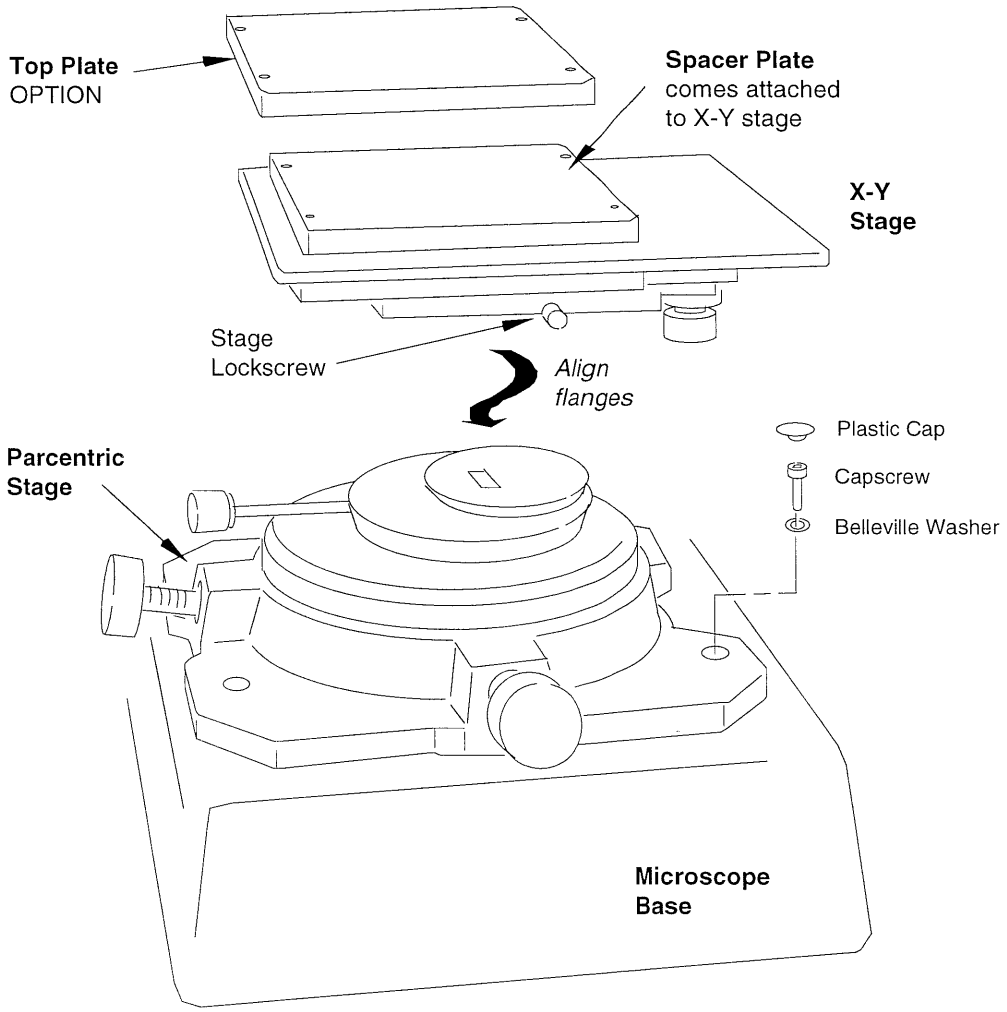
4. Assemble Support Stage

The parcentric stage is mounted to the Microscope base and then the X-Y stage is secured to its top; refer to Figure 2-6.

1. Place the parcentric stage on the Microscope base. Align the holes in the stage to the holes in base.
2. Place a capscrew and Belleville washer in each corner of the parcentric stage. Use a 5/32-inch Allen wrench to loosely secure each stage mounting capscrew.
3. Use a 2.5 mm Allen wrench to attach the Spacer Plate to the X-Y stage with four M3 capscrews.

4. Mount the Top Plate with three M3 capscrews, if supplied.

5. Align the flange in the X-Y stage to the flange in the parcentric stage. Visually align the sides of the X-Y stage parallel to the edges of the Microscope base. Secure the X-Y stage in position by tightening the Stage Lockscrew.

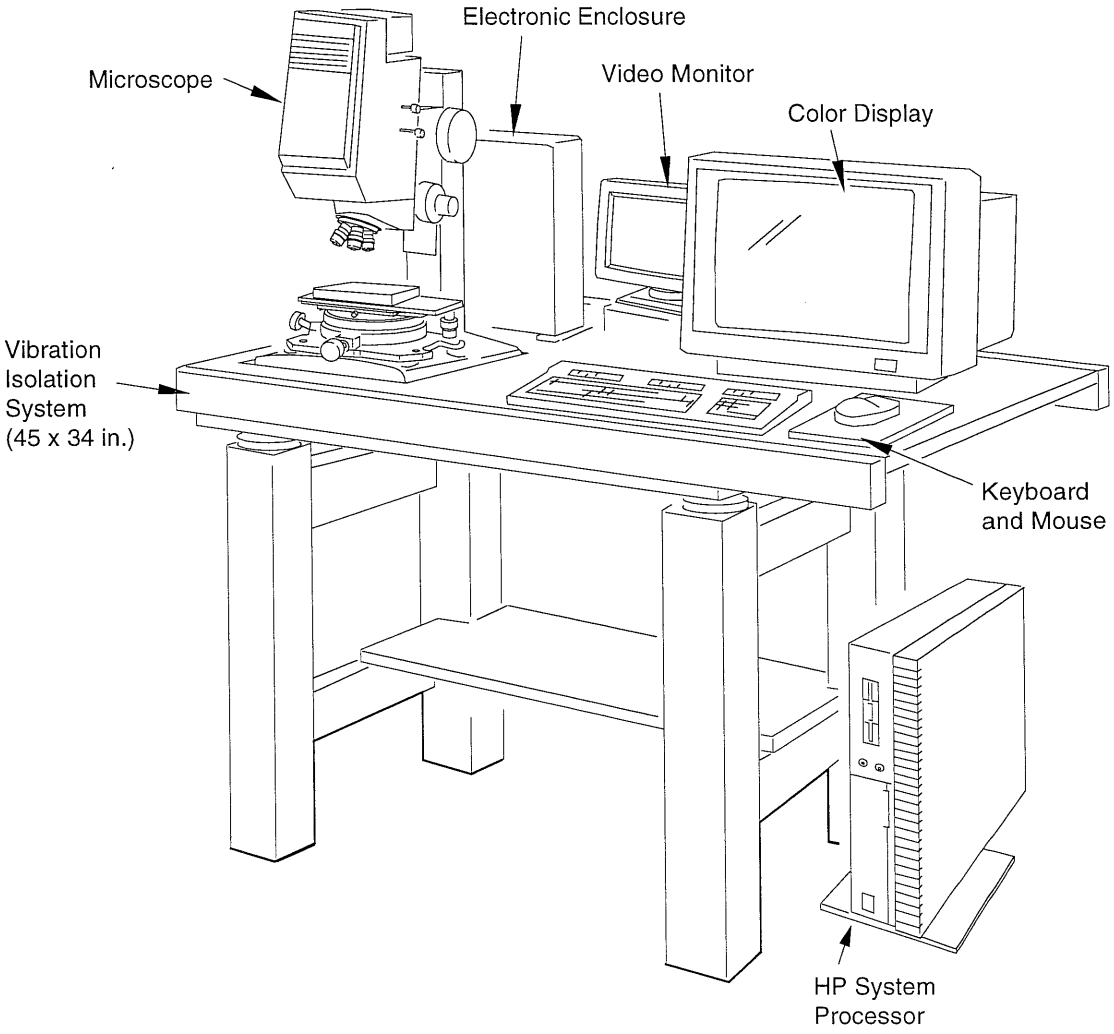


Installing the Support Stage

Figure 2-6

5. Position Components

The minimum recommended size and space requirements are shown in Figure 2-7. The Video Monitor is placed on a Plexiglas stand and positioned next to the Microscope so you can see the monitor and the test parts at the same time. The Enclosure should be placed 6 inches behind the Microscope.



Recommended Component Layout
Figure 2-7

6. Connect Cables

The next two substeps are to connect the Microscope to the Electronic Enclosure, and connect the Microscope and System Processor components.

Connect Microscope Cables Refer to Figure 2-8.

WARNING!

You must wear the disposable ESD wrist strap when connecting the Microscope cable assembly; otherwise, you may damage sensitive electronic components. The Enclosure power cord must be connected to earth ground through a grounded outlet for proper ESD grounding. Ensure that the power switch is off.

1. Adhere the copper foil end of the disposable wrist strap to the Electronic Enclosure on an unpainted metal surface and place the strap around your wrist. Plug the Enclosure power cord into a grounded outlet.
2. Remove the Enclosure's two cover screws (one on each side of the cover). Remove the cover by pulling it up from the bottom and then away.

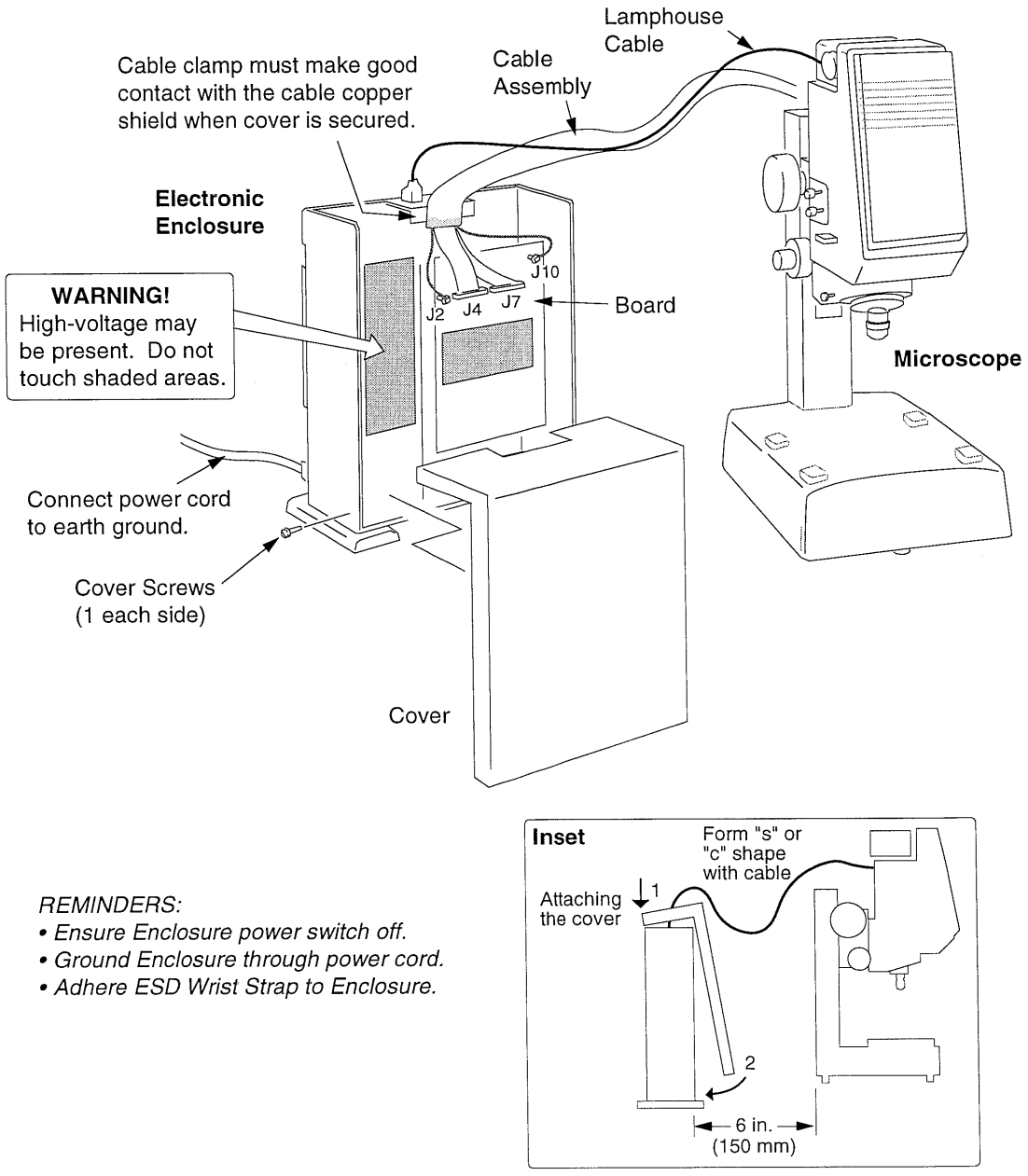
WARNING!

Do not touch the high voltage section on the circuit board or the power supply.

3. Route the cable so it is not twisted, and connect the ribbon connectors to J4 and J7 and the SMB connectors to J2 and J10 on the board mounted inside the Enclosure.
4. Position the cable so its braided mesh contacts the unpainted metal surface and the foam cable clamp on the Enclosure. Install the Enclosure cover by hooking the top and then swinging the cover into place. (See inset of Figure 2-8.) Secure the cover with two cover screws.
5. Plug the lamp house cable into the connector on top of the Electronic Enclosure. Position the Enclosure about 6 inches behind the Microscope so the cable forms an "s" or "c" shaped loop and is not strained.

Connect Component Cables Refer to Figure 2-9.

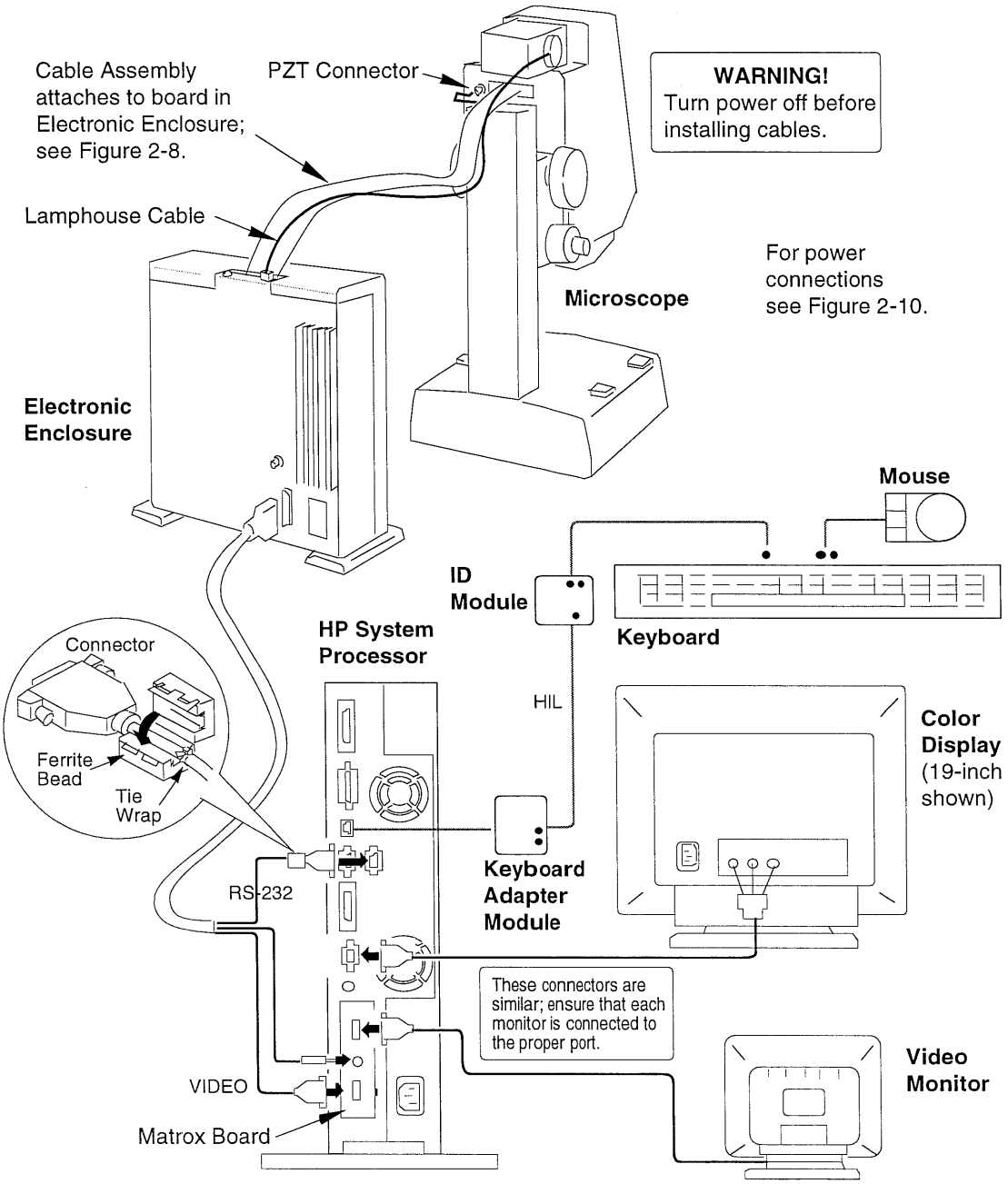
Cables shown for the System Processor are for reference only; connect these cables following the suggestions in the HP documentation.



REMINDERS:
- *Ensure Enclosure power switch off.*
- *Ground Enclosure through power cord.*
- *Adhere ESD Wrist Strap to Enclosure.*

Connecting the Microscope Cable

Figure 2-8



Cable Interconnection

Figure 2-9

7. Connect Power

Figure 2-10 shows power distribution for the system. Observe the following warnings.

100V or 120V Power Distribution

A 120V, 15 amp, 5 outlet, power strip is used for power distribution. Use the power jumper cords that come with the HP computer components.

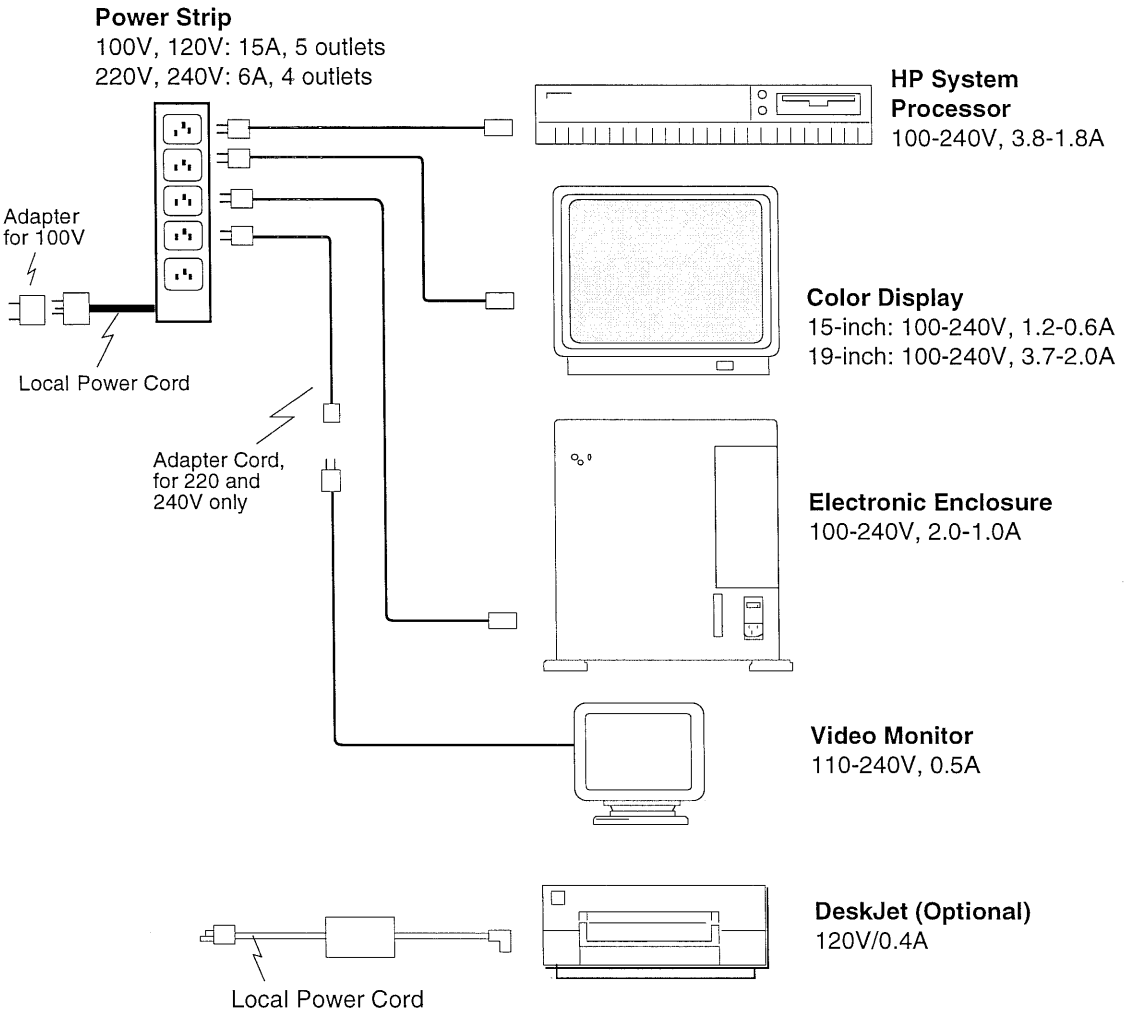
220V or 240V Power Distribution

The Zygo Electronic Enclosure, Video Monitor, and HP System Processor components automatically adjust for multiple line voltages; no configuration is required. A universal, 6 amp, 4 outlet, power strip is used for power distribution; it accepts 100, 120, 220, or 240 VAC. The cords that come with the HP computer components are not used, as Zygo supplies the required jumper cords for use with the universal power strip. A local power cord is supplied for the universal power strip to match the plug requirement for your area.

WARNING!

Ensure that all power is off when connecting cables.

The equipment is intended to be electrically grounded. It is equipped with a grounding plug to fit a grounding-type AC outlet. Ensure that the components are properly grounded through the outlet.



Power Distribution

Figure 2-10

8. Install MetroPro

The next step is to install the software; it is required before you can complete your installation.

1. To install MetroPro, follow the instructions titled "Installing and Updating MetroPro" located in Chapter 3 of *Getting Started with MetroPro, OMP-0346.*
2. After MetroPro is installed, complete the licensing requirements as explained in Chapter 4 of OMP-0346.
3. Open or login into MetroPro as explained in Chapter 5 of OMP-0346.

Later, after installation is complete, take some time to learn how to use the software and make the instrument do what *your* application requires.

9. Align Lamb Bulb

The lamb bulb is factory aligned. To check and to align the lamp bulb, complete the following procedure and refer to Figure 2-11.

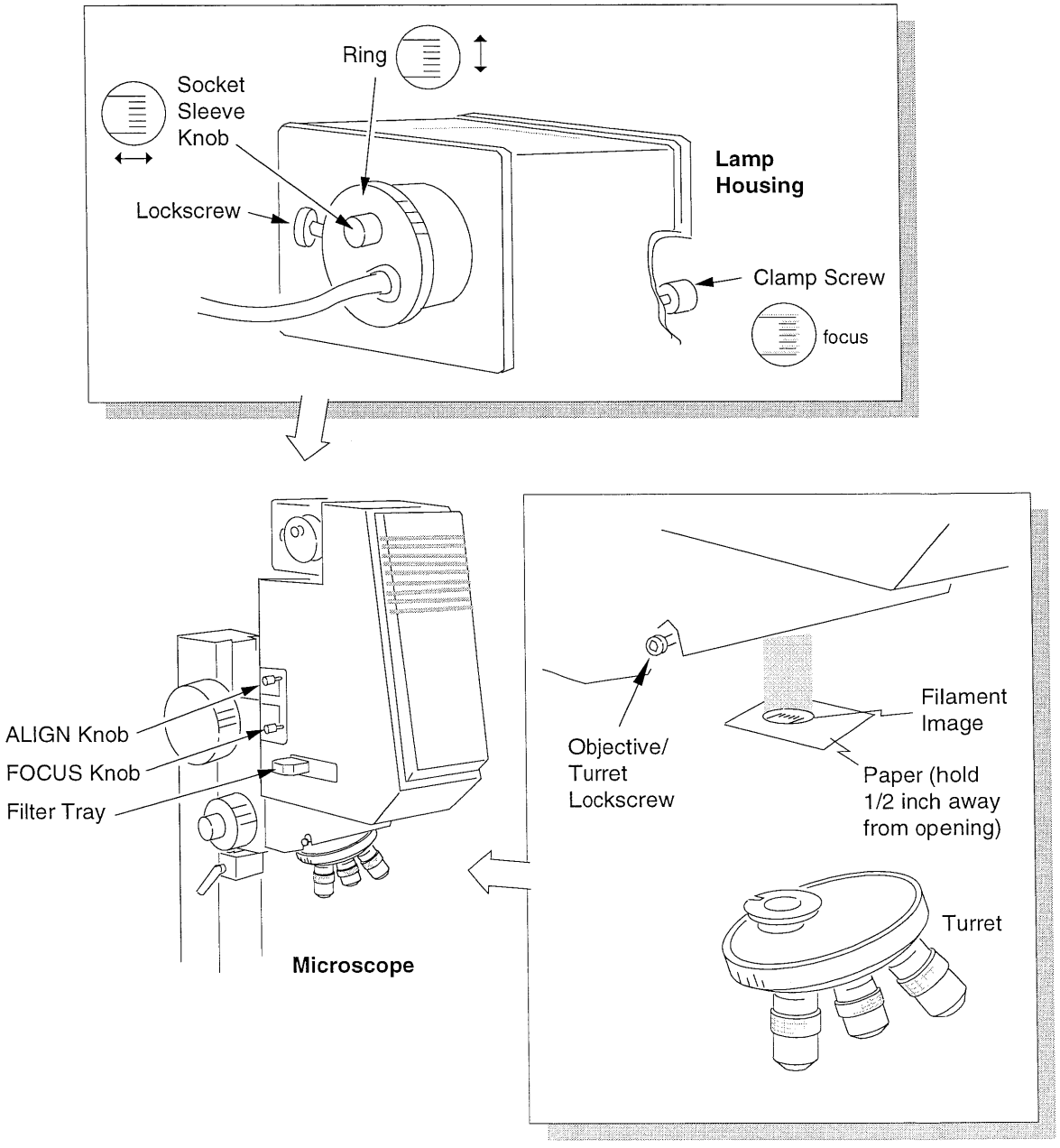
Note:

The turret or 2.5X objective must not be in place to align the lamp bulb.

1. Position the FOCUS and ALIGN knobs in the measure position, and the filter tray at the λ1 detent.
2. Hold a small piece of paper under the Microscope head, locate it about 1/2 inch under from the head.
3. Adjust the light intensity of the Microscope until a filament image is observed on the paper.
4. Adjust the filament image for best focus by loosening the clamp screw and moving the lamp housing up and down. When best focus is achieved, tighten the clamp screw.

5. Center the filament image from front to back by loosening the lockscrew and rotating the ring. When centered, tighten the lockscrew.

6. Center the filament image from side to side by turning the socket sleeve knob.



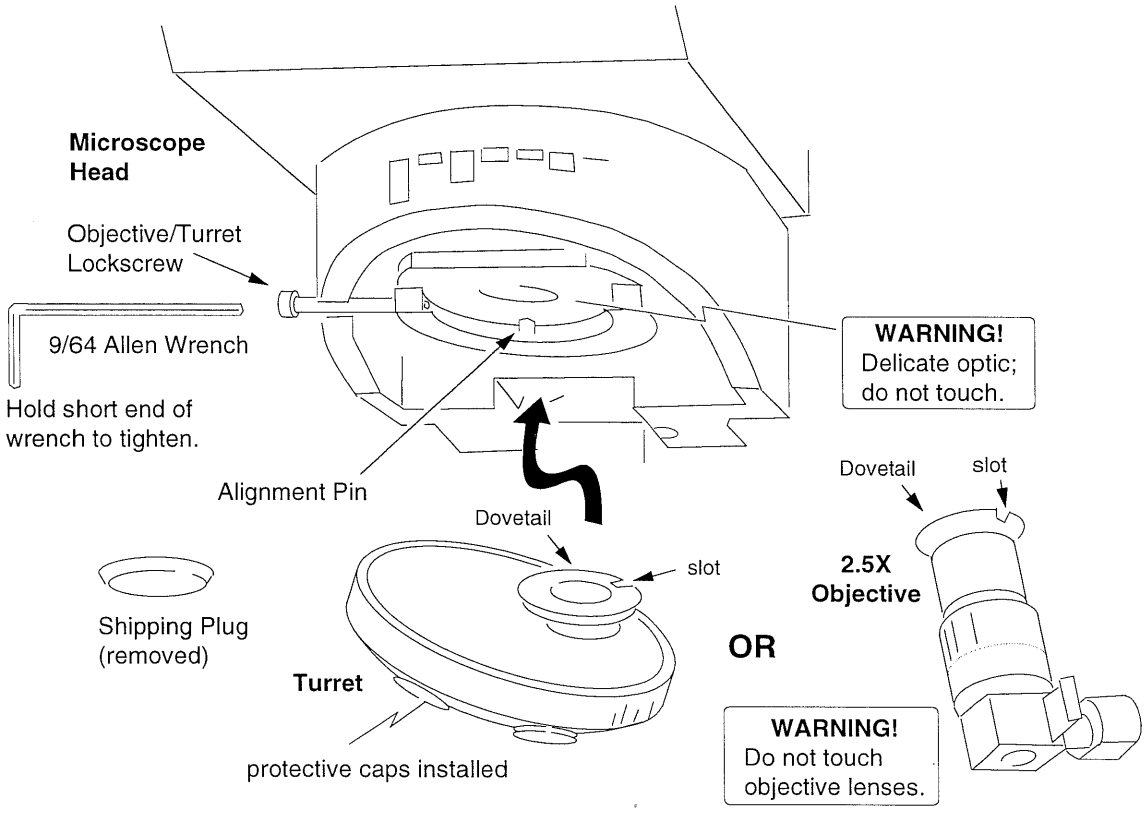
Aligning the Lamp Bulb

Figure 2-11

10. Install Turret or 2.5X Objective

Install the turret assembly or a the 2.5X objective as shown in Figure 2-12.

1. Loosen the objective/turret lockscrew with a 9/64 inch Allen wrench and remove the shipping plug. Save the plug.
2. Align the slot in the dovetail to the alignment pin on the head and slide the turret or objective into place.
3. Holding the short end of a 9/64 Allen wrench, lightly finger tighten the objective/turret lockscrew.



Installing the Turret or the 2.5X Objective

Figure 2-12

11. Mount Objectives on Turret

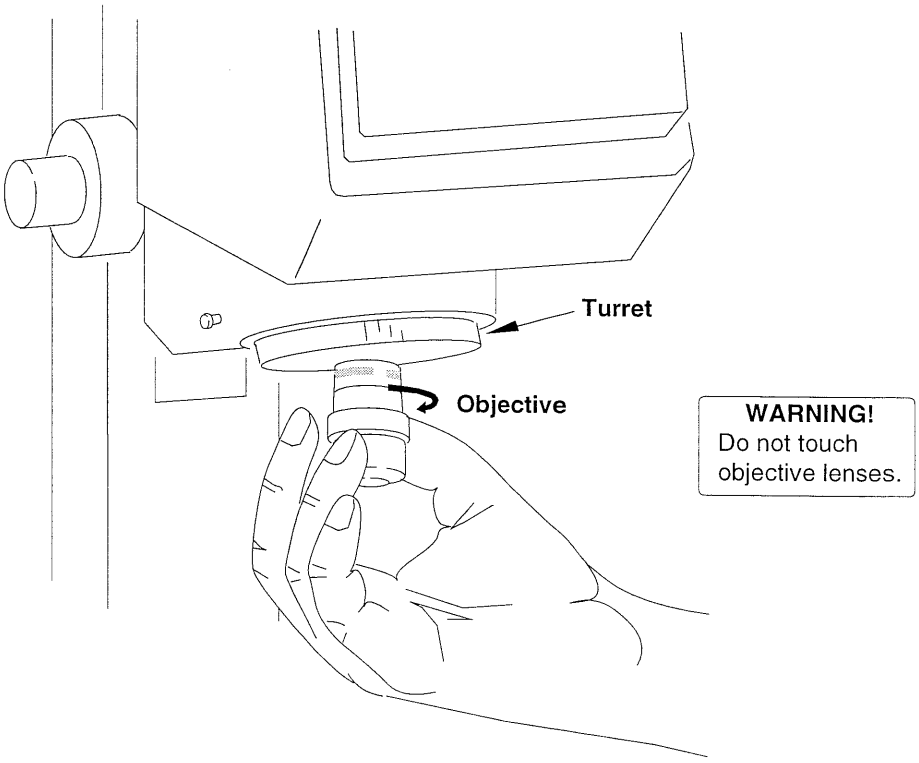
To install objectives on the turret, refer to Figure 2-13. The 2.5X objective cannot be turret mounted. Up to five objectives can be accommodated. Unused objectives should be stored in their protective cases.

1. Remove the protective cap from the turret by turning it counterclockwise.

WARNING!

Do not touch the objective lenses. Dust, dirt, and finger prints can impair the system's optical imaging and harm delicate lens coatings.

2. Remove the objective from its protective case.
3. Thread the objective clockwise into the hole in the turret. Finger tighten.



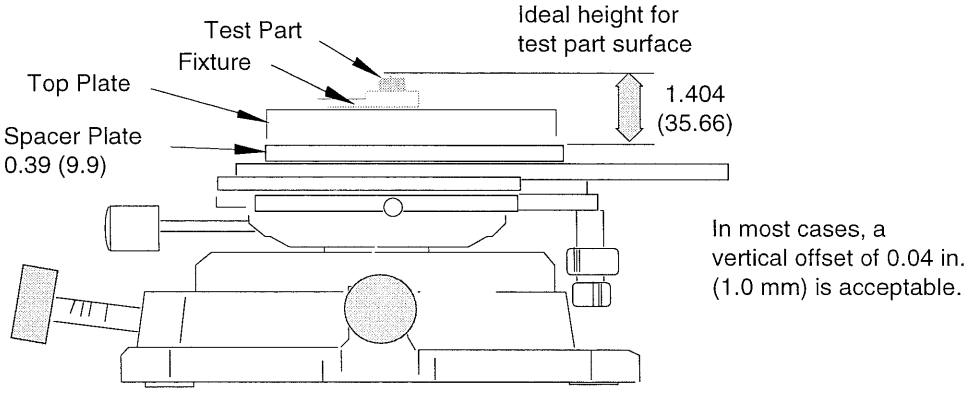
Mounting an Objective in the Turret

Figure 2-13

12. Align Support Stage

For the Support Stage to provide parcentric tip/tilt adjustments, two alignment conditions should be met. The closer these two conditions are achieved, the easier it is to align and focus the Microscope on test parts.

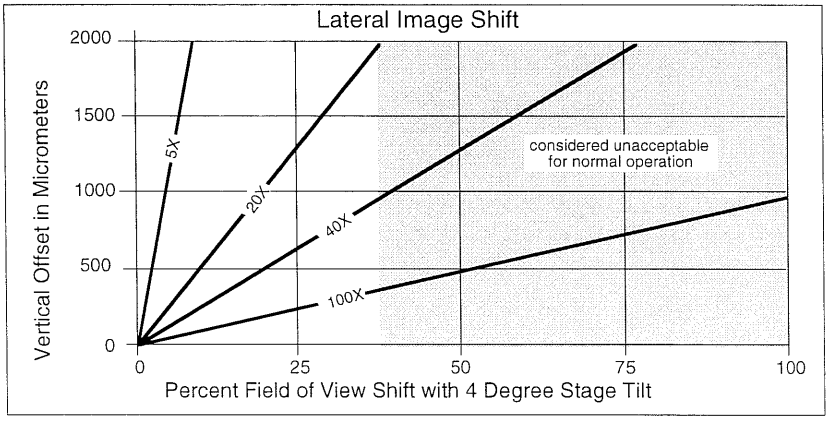
- *Stage Lateral Alignment* The Stage should be laterally aligned under the objective in use to keep the part in focus as stage tip and tilt is adjusted. Two methods are provided for lateral alignment.
- *Part Height* The part surface being measured should be located 1.404 inches (35.66 mm) above the Spacer Plate mounted on the X-Y Stage to minimize the part from moving laterally in the field of view as tip and tilt is adjusted. See Figure 2-14.



Part Height

Figure 2-14

The higher the objective magnification, the greater the impact of vertical offset in the part and stage misalignment. The impact of vertical offset is represented in the following graph.



Stage Lateral Alignment

Two different procedures are provided; select one. The first procedure requires an alignment aid from Zygo. The second procedure is more of a trial and error process.

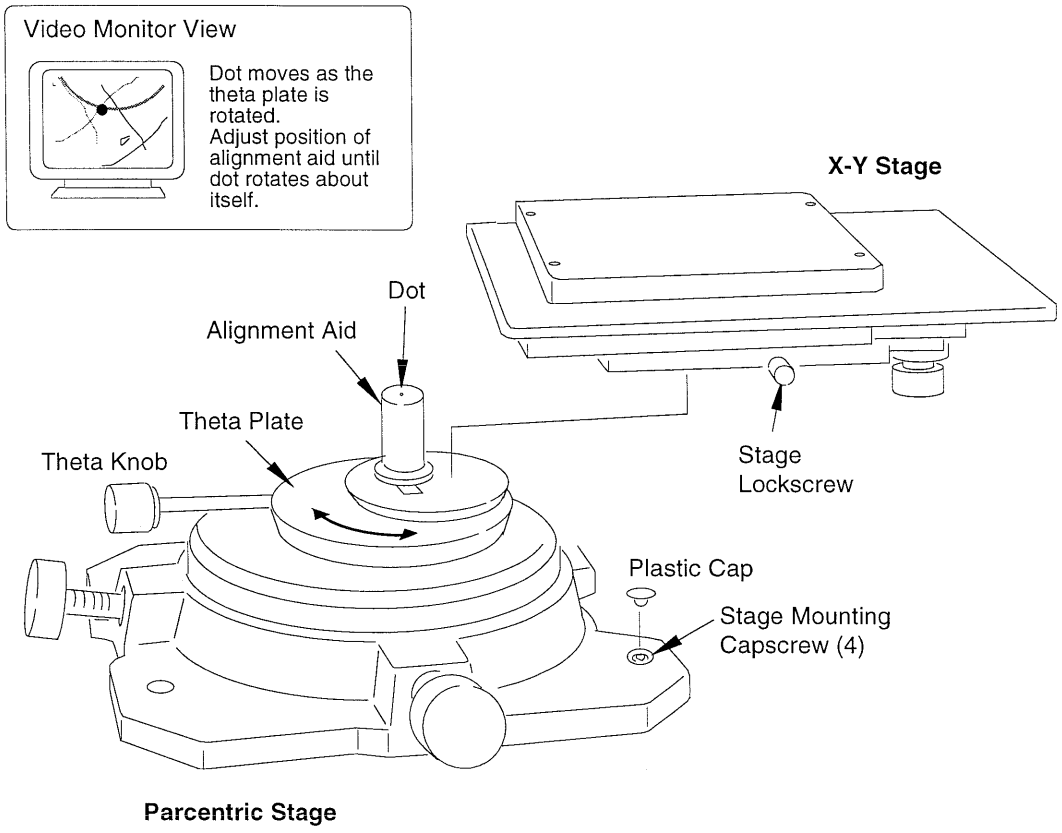
Note:

Before performing the stage alignment procedure, the instrument has to be operational and MetroPro running. You may like to review Chapter 3 before proceeding.

Method 1 - Stage Alignment using an Alignment Aid

The alignment aid is placed on the stage and the Video Monitor is observed as adjustments are made. Refer to Figure 2-15.

1. Loosen the stage lockscrew and remove the X-Y stage if it is attached to the parcentric stage.
2. Use a 5/32-inch Allen wrench to tighten the four stage mounting capscrews until they just start to compress the Belleville washers, and the parcentric stage is still movable.
3. Adjust the tip and tilt so the parcentric stage is visually level.
4. Using a marker, put a small dot on the alignment aid. Place the alignment aid on the parcentric stage under the objective. Focus on the dot; fringes are not necessary. Move the aid if necessary to see the dot.
5. Slightly loosen the X-Y stage theta knob. Rotate the theta plate and observe the Video Monitor. The dot will rotate about some axis. Adjust the position of the alignment aid half the way to the center of the rotation seen on the monitor. You are done when the dot rotates about itself as the theta plate is rotated.
6. Move the stage in x and y to center the dot on the Video Monitor.
7. If the best possible stage alignment is desired, recheck the alignment following steps 5 and 6 above, but use a 20X objective.
8. Secure the Stage in position by tightening the four stage mounting capscrews and place the plastic caps over the holes.
9. Rotate the theta plate until the Theta knob is aligned parallel to the x-axis of the stage. Tighten the theta knob.
10. Reattach the X-Y stage to the parcentric stage.



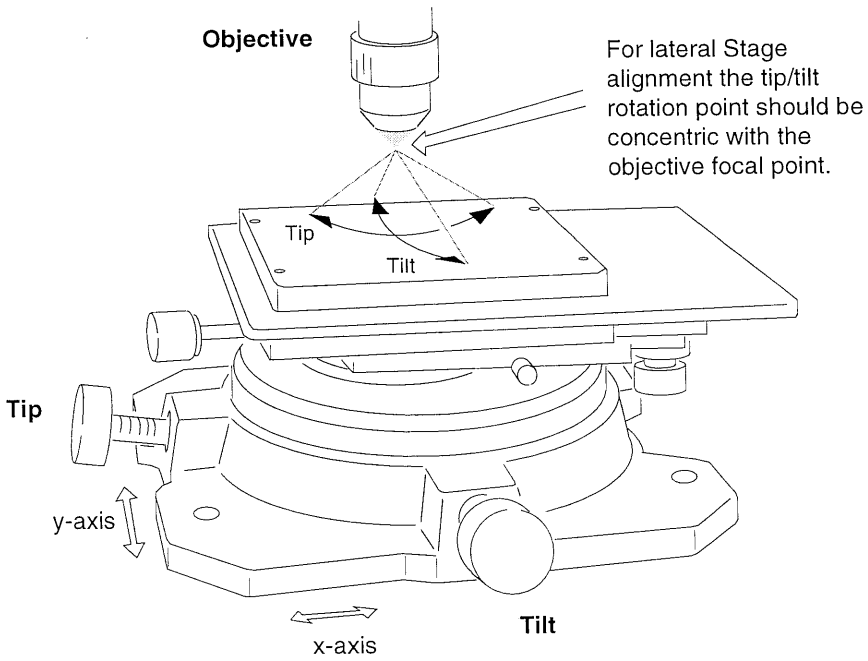
Using the Stage Alignment Aid
Figure 2-15

Method 2 - Stage Alignment by Trial and Error

The Stage is laterally aligned by viewing a reflective part, watching the effects of the tip and tilt adjustments, and then adjusting the location of the Stage. Refer to Figure 2-16.

1. Install the highest magnification objective you plan to use. Start with a 20X objective if possible.
2. Use a 5/32-inch Allen wrench to tighten the four stage mounting capscrews until they just start to compress the Belleville washers, and the stage is still movable.
3. Adjust the tip and tilt so the X-Y Stage is visually level.

4. Place a test part under the objective, at the proper height (± 1 millimeter) as described previously. Focus on the part, achieving the best possible fringe contrast.
5. Adjust the tip one way until the fringes become denser and then begin to fade off the Video Monitor.
6. Move the stage in the x-axis so the fringes come back onto the Video Monitor.
7. Adjust the tip in the opposite direction and repeat the procedure outlined in steps 5 and 6. Try to reach a balance between both positions. The high contrast fringes should remain after adjusting tip in either direction.
8. Repeat the techniques outlined in steps 5 through 7 to adjust tilt and move the stage in the y-axis.
9. This process is complete when the darkest fringe stays within a few fringe widths of the center of the Video Monitor when the X-Y stage is tilted.
10. Secure the Stage in position by tightening the four stage mounting capscrews and place the plastic caps over the holes.



Lateral Alignment of the Motorized Stage

Figure 2-16

Chapter 3
OPERATION

In This Chapter

OPERATION OVERVIEW

This section provides an overview of Maxim•GP operation. It includes:

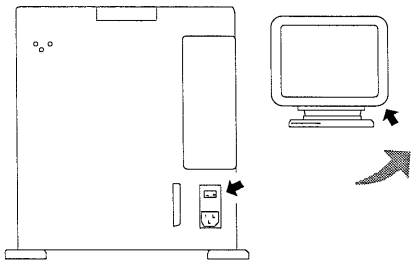
- Start Up
- Making a sample measurement
- Shutdown

Greater details on using the Maxim•GP are covered in later sections.

Start Up

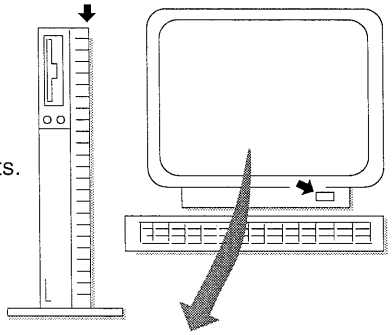
STEP 1

Turn on Microscope components. Wait 15 seconds.



STEP 2

Turn on computer components.



STEP 3

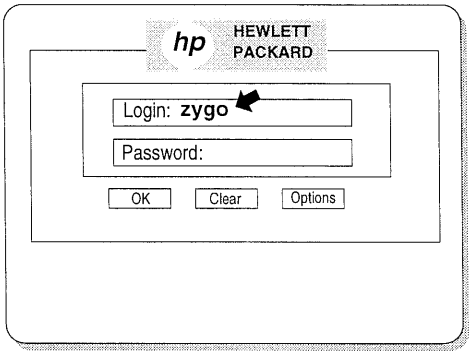
Wait until the HP Login screen appears. After Login type:

zygo Return

When asked a question about the date, press:

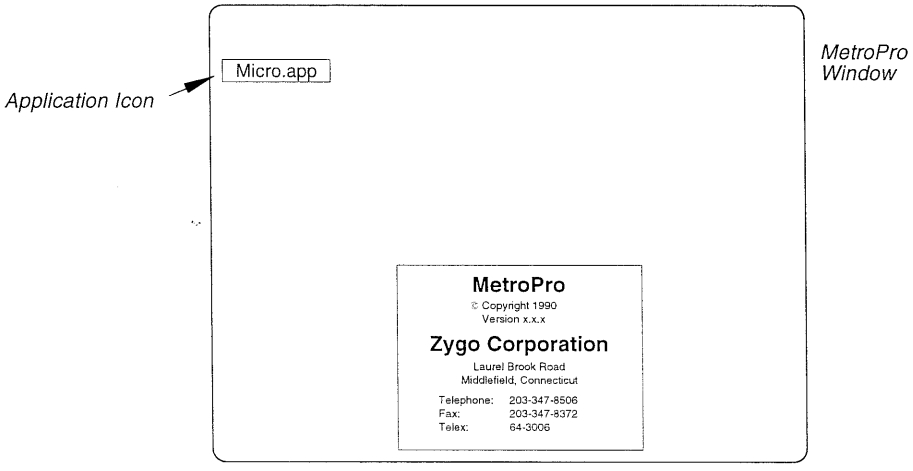
Y Return

MetroPro software automatically opens after login.



screen display

To open an application, click on the icon once with the left mouse button.

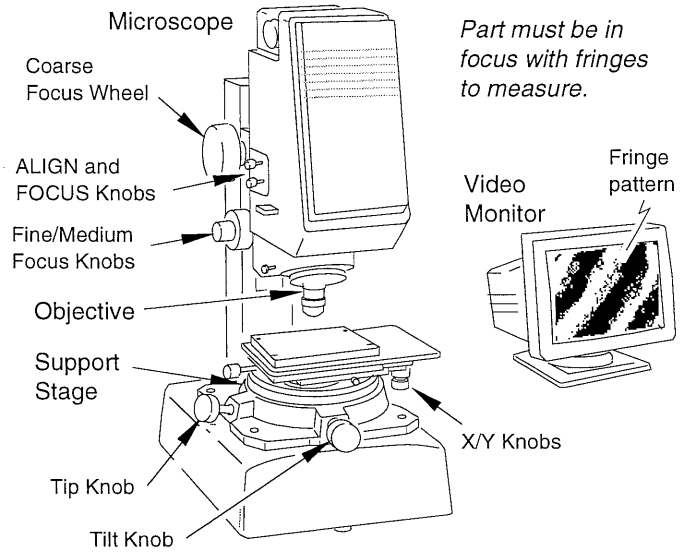


MetroPro Window

Sample Measurement

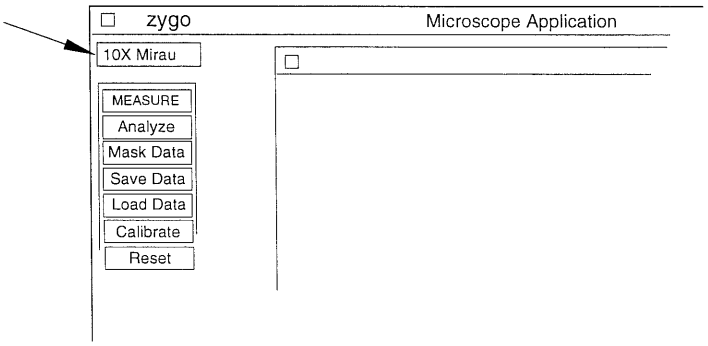
More details provided on pages 3-9 thru 3-12.

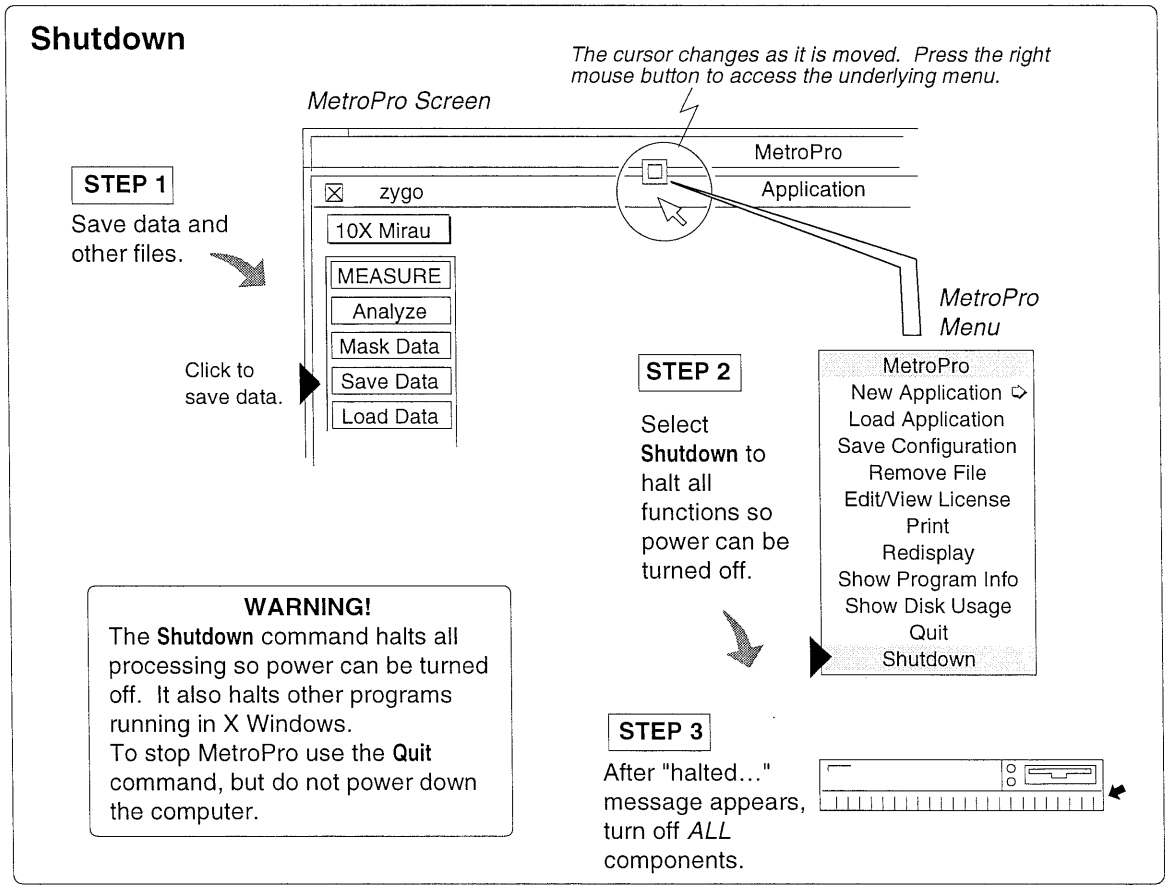
1. Place part on Support Stage under objective.
2. Turn coarse and medium focus controls to bring objective near to part surface. Bring the objective slightly closer than its working distance.
3. Locate the part under the objective by turning the Stage X and Y knobs.
4. Focus by turning the fine and medium focus knobs so the head moves slowly upward. Adjust focus for surface detail and fringes (contrasting bands).
5. Turn the Stage tip and tilt knobs to minimize the number of fringes. Readjust focus and part location if necessary.
6. Click the mouse on the **Objective** button until it displays the objective power in use.
7. Press **F1** to measure. Results are calculated and then displayed.



Objective	2.5X	5X	10X	20X	40X	100X
Distance (mm)	11.1	9.0	4.0	2.5	4.5	0.6

MetroPro Screen





THE MAXIM•GP CONTROLS

The pages that follow provide a complete discussion of the Maxim•GP controls. It covers:

- Microscope
- Support Stage
- Electronic Enclosure
- Video Monitor
- Light Level

Microscope Controls

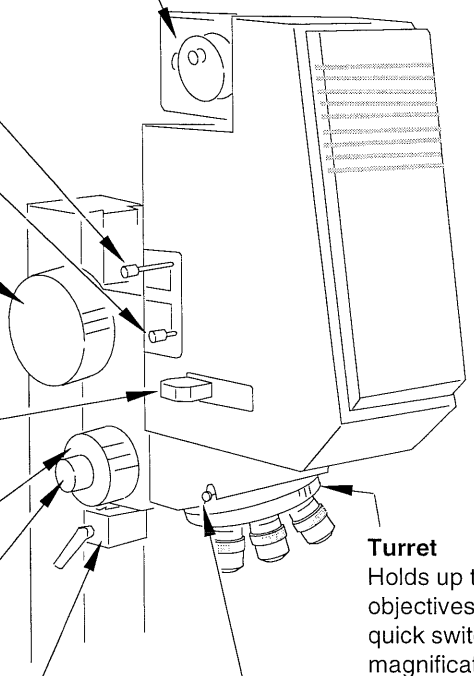
Light Centering Controls
Use to adjust for proper illumination when replacing the bulb.

Some controls are also accessible on the right side of the Microscope.

ALIGN Knob
Use with low power objectives as tip/tilt adjust aid. Pull out to align, in to measure.

FOCUS Knob
Use as focus aid. Pull out to focus, in to measure.

Coarse Focus Wheel
Use to move the head large distances, such as when replacing objectives or the test part; it moves the head 22 mm per turn.
The wheel torque is increased by turning the right-side wheel in the direction of the arrow (→Tension) while holding the left-side wheel.



Filter Tray
Three position: FOCUS to aid focusing 2.5X and 5X objectives, λ1 for taking measurements, and λ2 for two wavelength measurements.

Medium Focus Knob
Use for rough focusing; it moves the head 4.7 mm per turn.
The knob torque is increased by turning an inner ring counterclockwise.

Fine Focus Knob
Use for fine focusing; it moves the head 0.2 mm per turn.

Coarse Z-stop
Position under Microscope head to prevent objective from contacting the stage or test part. It must not contact the head.

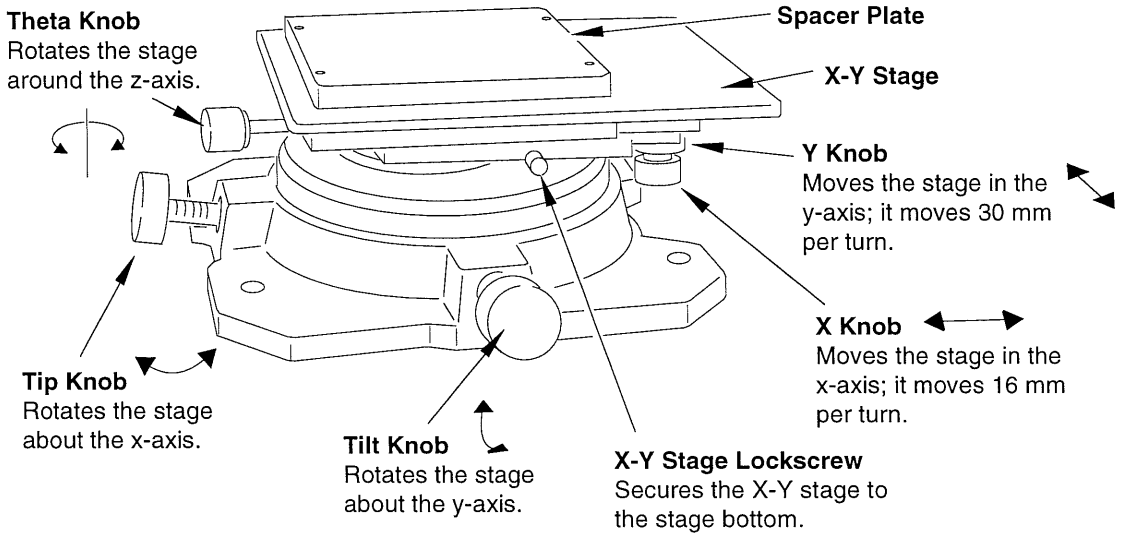
Turret
Holds up to five objectives. Allows quick switch of magnification.

Objective/Turret Lockscrew
Secures turret or single objective in position. Requires 9/64 Allen wrench.

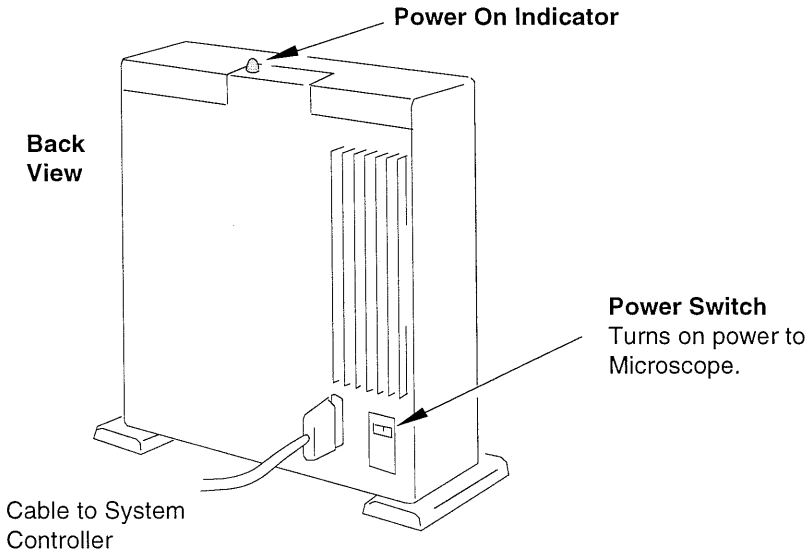
WARNING!
Be careful when adjusting the Coarse Focus Wheel tension. If the tension is too loose the head can fall under its own weight.

Be careful when focusing the Microscope so the objective does not contact the test part or Support Stage.

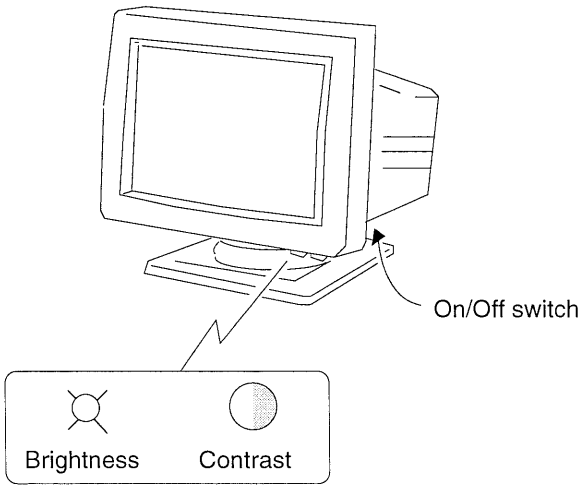
Support Stage Controls



Electronic Enclosure Controls

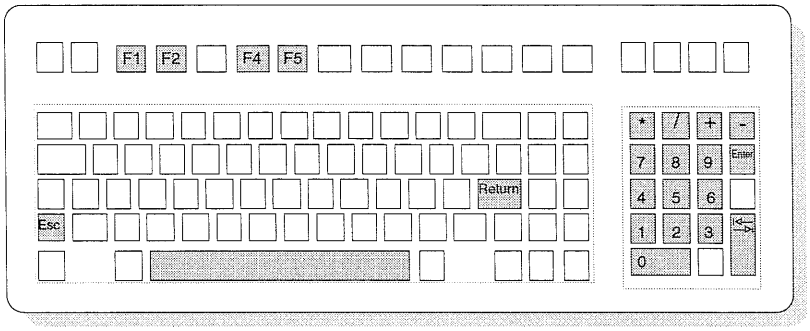


Video Monitor Controls



Operation Instructions
Pictures will not appear if the **Contrast** and **Brightness** controls are turned excessively in one direction. Adjust these controls for optimum picture quality.

Keyboard Controls



General Keys

F1 Measure; initiates a measurement.

F2 Analyze; recalculates the data.

F4 Open Light Level View window to aid in manual light level adjustment.

F5 Auto adjust light level. Press after adjusting focus for darkest fringes.

Esc Abort measurement.

Return Same as clicking YES or OK. Also completes a text entry.

space bar Stop measurement, process any acquired data

Light Level Keys

Use for manual light level adjustments.

Coarse up/down: * /

Fine up/down: + -

7 8 9

4 5 6

1 2 3

0

Enter — Close Light Level View window (or Return)

Toggle between last two settings

Number keys adjust light level in 10% steps:

1→10%

2→20%

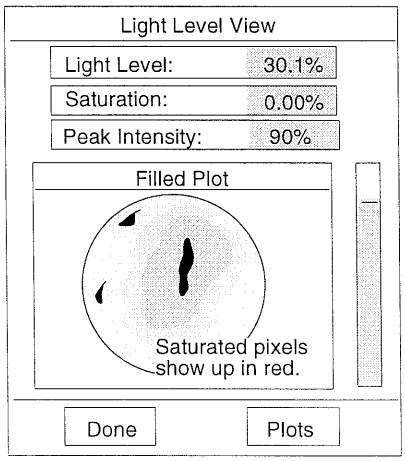
↓

0→100%

Optional Light Level Adjustment Aid

To open press F4.

To close press Enter.

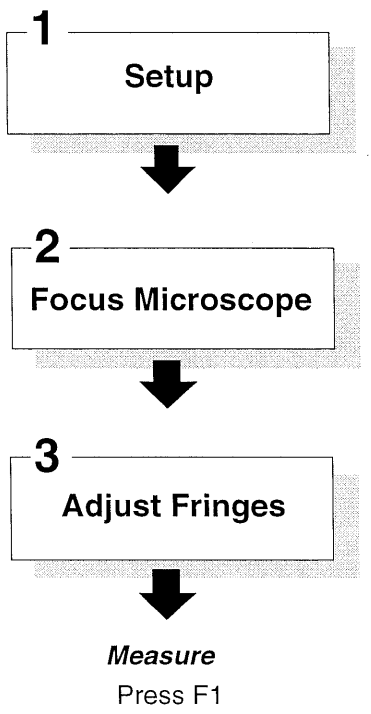


Adjust focus for the darkest fringes. Then, adjust light level with keyboard until all indicators are green. Do not allow any saturation.

USING THE MICROSCOPE

This following pages provide details on operating and adjusting the Maxim•GP.

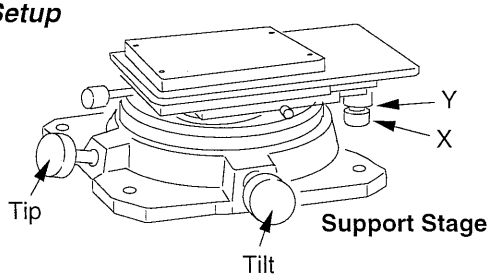
Simplified Measurement Overview

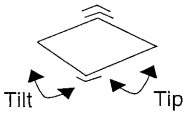


Each step is explained over the pages that follow...

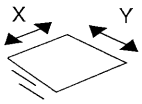
1 Setup

Part Setup





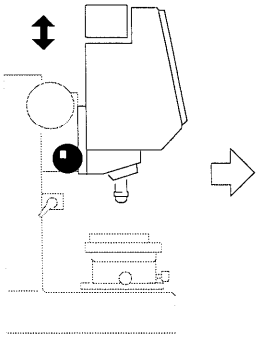
Level Stage



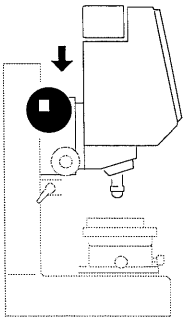
Locate part under objective

Microscope Setup

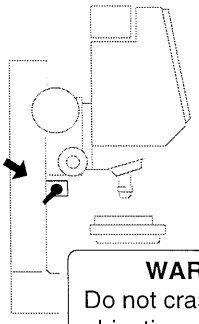
Objective	2.5X	5X	10X	20X	40X	100X
Dist. (mm)	11.1	9.0	4.0	2.5	4.5	0.6



Turn medium focus knob to position microscope head in the center of its travel.



Turn coarse focus wheel to position objective near its working distance from the test part.



Position Coarse Z-stop to stop objective from crashing into the test part or stage.

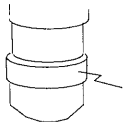
WARNING!
Do not crash the objective onto the test part or stage.
The z-stop should not contact the microscope head.

40X and 100X Objective Setup

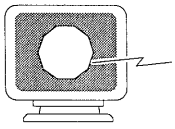
The 40X and 100X objectives are sensitive to temperature changes. For maximum performance the equal-path ring must be adjusted under the actual operating conditions.

1. Put Focus knob in focus position.
2. Adjust light level for even lighting.
3. Turn equal-path ring for sharp aperture.

Once the objective is adjusted under operating conditions it is not necessary to change the adjustment if those conditions do not change.

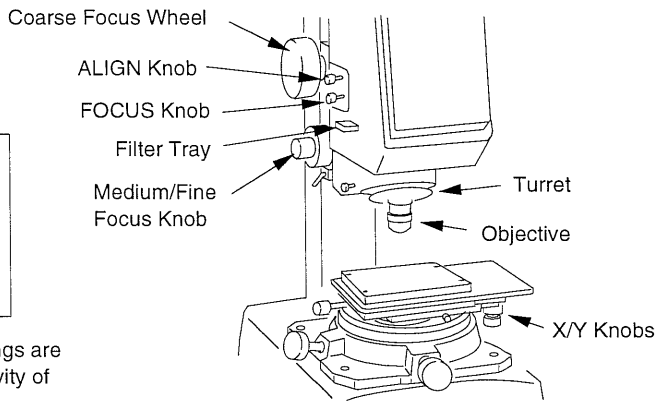


40X or 100X Objective



Video Monitor

2 Focus Microscope



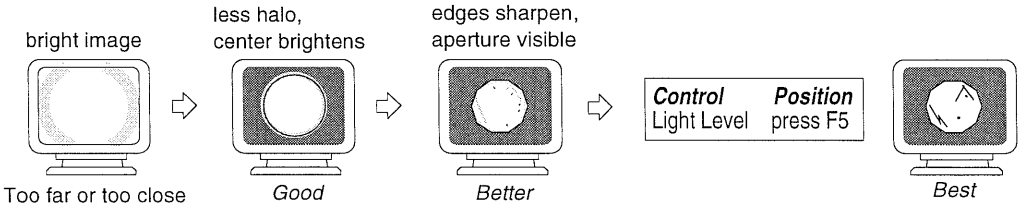
Set Controls to Starting Point

Control	*Position*	
ALIGN Knob	measure (in)	**Start**
FOCUS Knob	focus (out)	
FILTER	λ1	
Light Level	6 to 9 (1)	
Turret	select objective	
Focusing Controls	objective at working distance	

(1) Actual light level settings are dependent on the reflectivity of the part.

Objective	2.5X	5X	10X	20X	40X	100X
Distance (mm)	11.1	9.0	4.0	2.5	4.5	0.6

Coarse Focus



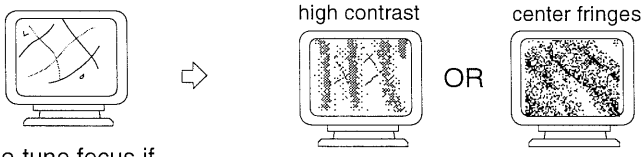
Control	*Position*
Light Level	press F5

Turn Medium and Fine Focus knobs to bring the brightness into the center of the aperture.

Fine-tune focus for surface detail, sharp aperture, and fringes.

Fine Focus

Control	*Position*
FOCUS Knob	measure (in)
Light Level	press F5
X + Y Knobs	turn to locate part



Fine-tune focus if necessary. Fringes must be visible.

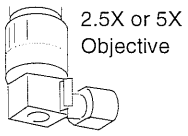
For smooth parts adjust focus for high contrast fringes. For rough or parts with steps center the focus between high and low fringes.

Important to center darkest fringe before measuring.

Adjust Fringes
next page

2.5X and 5X Focus Aid

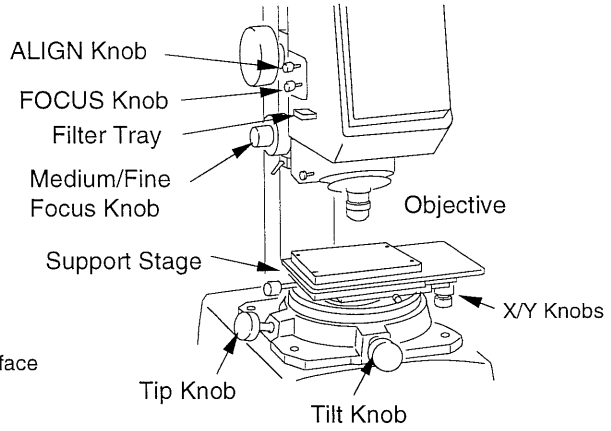
Filter FOCUS - helps to find fringes; must be set to λ1 to measure.

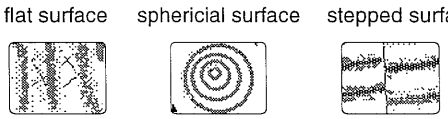


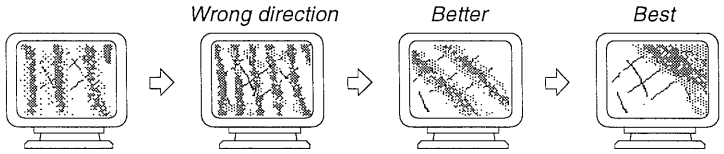
3 Adjust Fringes

Null Fringes

Nulling means to minimize the number of fringes; it varies depending on the shape of the test surface. For flat surfaces, reduce the number of fringes to as few as possible. For spherical surfaces, center the fringe pattern. For stepped surfaces, fringes should be positioned at right angles to the step.

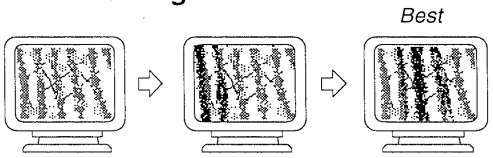






Turn the Tip and Tilt knobs to minimize the number of fringes.
Readjust focus and part positioning as necessary.

Center Darkest Fringes



Measure
press F1

Adjust focus to center the darkest fringe.

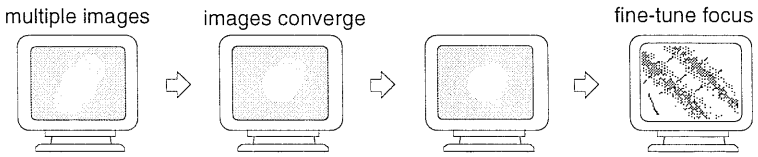
2.5X and 5X Nulling Aid

Control	*Position*
ALIGN Knob	align (out)
FOCUS Knob	focus (out)
FILTER	λ1
Light Level	6 to 9 (1)

Start Settings

Control	*Position*
ALIGN Knob	measure (in)
FOCUS Knob	measure (in)
Light Level	press F5

End Settings



Adjust the Tip and Tilt knobs to centralize the multiple circular images.

(1) Actual light level settings are dependent on the reflectivity of the part.

OPERATION HINTS

This following pages provide hints for using the Maxim•GP efficiently. This section includes:

- Use System Error Files
- Selecting the Right Objective
- MetroPro Controls Used Most Often

Use System Error Files

To eliminate optical artifacts and obtain optimum performance, create a system reference file for each objective and subtract this file from each measurement. Note that if the objective is taken out and put back in, or if the reference leg of Michelson objective is rotated, that the error file must be remade. Refer to the *Microscope System Error Application* booklet, OMP-0361.

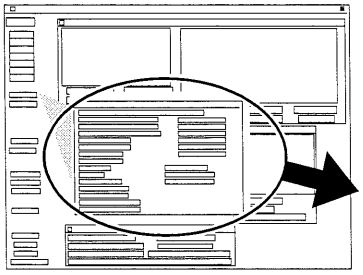
Selecting the Right Objective

Its up to you to determine what parameters of the test sample you want to measure and then select the best objective for that task. Here are some considerations:

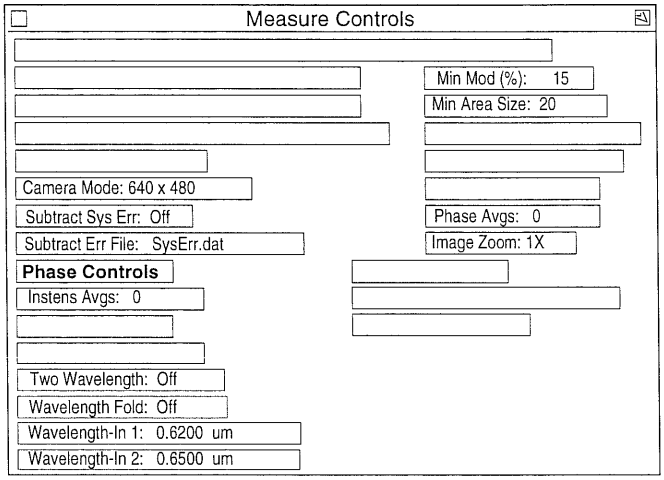
- *Power*
  Match the objective field size to the area of interest you want to measure. Low magnification objectives measure widely spaced surface characteristics; high magnification measure finer detail.
- *Lateral Resolution*
  There is a tradeoff between objective power and lateral resolution. The higher the magnification, the greater the lateral resolution, but the smaller the field of view. Vertical resolution is constant, regardless of the objective.
- *Multiple Objectives*
  Multiple objectives mounted on the turret provide maximum flexibility. The 10X, 20X, 40X and 100X objectives are parfocal allowing you to switch between objectives with minimal refocusing.
- *Work Smart*
  Use a low magnification objective to locate an area of interest before switching to a higher power. Use a high magnification objective to help you focus a part that may be difficult to focus with a low power objective.
- *See page 1-10 for Objective Specifications.*

MetroPro Controls Used Most Often

MetroPro Microscope Application Screen



Software is described in the MetroPro Reference Guide, OMP-0347



The controls are in the Measure Controls window.

Measure Cntrl

Controls when using two wavelengths.

Camera Mode

Camera Mode selects the effective camera size in pixels. More pixels resolve smaller details, but increase processing time. Click to change.

Subtract Sys Err

Sys Err File

Subtracting system errors is useful for all measurements to subtract instrument aberrations during the analysis cycle. Subtract Sys Err activates the function. Sys Err File specifies the name of a data file to subtract. Error files should be made for each objective.

Min Mod (%)

Min Mod (%) specifies the minimal percentage of full modulation for each camera pixel to be accepted as a valid data point. Lower the setting when there are data dropouts and the roughness looks okay. Click to enter a numeric value.

Min Area Size

Min Area Size specifies the number of data points in a valid region. Lower the setting to accept smaller areas; increase to accept larger areas and reject smaller. Click to enter a numeric value.

Two Wavelength Controls

Nominal values shown. Actual values will vary.

Two Wavelength: Off

Activates two wavelength measurements when On. Click to change.

Wavelength Fold: On

When On, improves the measurement of smooth surfaces. Turn Off when measuring rough parts near the roughness limits. Click to change.

Wavelength-In 1: 0.6200 um

Wavelength-In 2: 0.6500 um

Specify the wavelength of the λ1 and λ2 filters in the filter tray. Normally read in from a system calibration file at startup. Must enter numbers for the optional 10 µm Step filters. Click to enter a numeric value.

TWO WAVELENGTH MEASUREMENTS

Two wavelength measurement capability comes standard with the Maxim•GP. This allows you to measure surfaces that have steeper slopes, rougher finishes, and higher steps than you can measure using a single wavelength. The table below shows the extended measurement range.

Measurement Limits

Technique	*Roughness (Ra) Limit*	*Step Height Limit(1)*
One Wavelength	0.10 µm	0.16 µm
Two Wavelength Standard Filters	0.40 µm	2.5 µm
Two Wavelength Optional 10µm Step Filters	0.10 µm	10.0 µm

(1) For 20X, 40X, and 100X objectives, the two wavelength step height measurements are limited by the objective's depth of focus, which is 3.5 µm, 1.8 µm, and 0.6 µm, respectively.

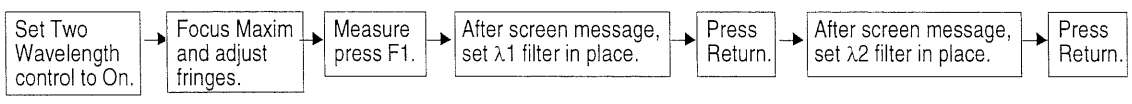
When to Use Two Wavelengths

Use two wavelength measurements when you know your test sample has a surface roughness greater than 0.10 micrometers (4.0 µin) or has a step height larger than 0.16 micrometer (6.38 µin).

If you don't know the part roughness or step height, try a single wavelength measurement and a two wavelength measurement. If the results are similar between both measurements, use a single wavelength. If the single wavelength measurement shows missing data in the plots, it may indicate the need for two wavelengths.

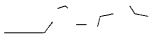
Making Two Wavelength Measurements

Two wavelength measurements are activated by clicking on the MetroPro *Two Wavelength* control. The previous drawing provides information on the MetroPro controls for two wavelength measurements. An overview is shown below.



Considerations When Using Two Wavelengths

- *Fringe Stability*
  Make sure the interference fringes are stable before making a measurement. If there is vibration or fringe drift when the instrument is acquiring data the results are suspect. To help reduce this problem, use intensity averaging by setting the MetroPro *Intens Avgs* control from 2 to 4.
- *Part Stability*
  If the part is not supported in a stable manner errors may occur. With two wavelength measurements, lateral stability of the stage is important, particularly with 40X and 100X objectives. A part that drifts a pixel or more between the first and second wavelength measurements will have a characteristic alternating upward and downward spikes at positive and negative step transitions.
- *Fringe Contrast*
  When measuring a single plane surface, adjust the focus and tip/tilt so the fringe with the darkest contrast is centered over the image. When measuring a stepped surface, adjust the focus and tip/tilt so the fringe intensity is visually equal on both sides of the step.
- *Invalid Data*
  Surfaces with large very sharply defined steps may cause invalid data when a high to low transition falls on a single camera pixel. This edge effect problem can throw off the connect processing and produce invalid results; a step will appear to have a spike at the plateau and at the valley. To minimize this effect, set the MetroPro *Pre-Connect Filter* control to 60 or greater.
- *Things to Watch For...*

Profile Result	*Corrective Action*
	Ensure part stabilizes before measuring.
	Use Pre-connect Filter control.
	Clean part; turn Wavelength Fold control off.
 (missing data)	Refocus and measure; lower Discon Filter.
 > 2.5 µm	Verify step height on other type instrument.

Two Wavelength Theory

With phase shifting interferometry, an assumption is made that the height change between a light and dark fringe on two adjacent camera pixels is less than half a fringe displacement (one/half fringe order). This allows surface regions with slopes up to half a fringe per pixel to be reconstructed. Regions with greater slopes cannot be measured correctly.

Because the light is reflected from the test surface, the half a fringe limit is equal to a height change on the surface of one-quarter of the measurement wavelength, thus making the resolvable height change between two adjacent pixels $\lambda/4$. For example, a 640 nanometers light source has a theoretical height change limit of 640 divided by 4, or 160 nanometers across two pixels. Therefore, the larger the wavelength, the greater the height change that can be measured.

When two wavelength measurements are used, two sets of data are taken at two separate wavelengths. Software then combines these to simulate a large, synthetic wavelength.

The new synthetic wavelength is given by the formula:

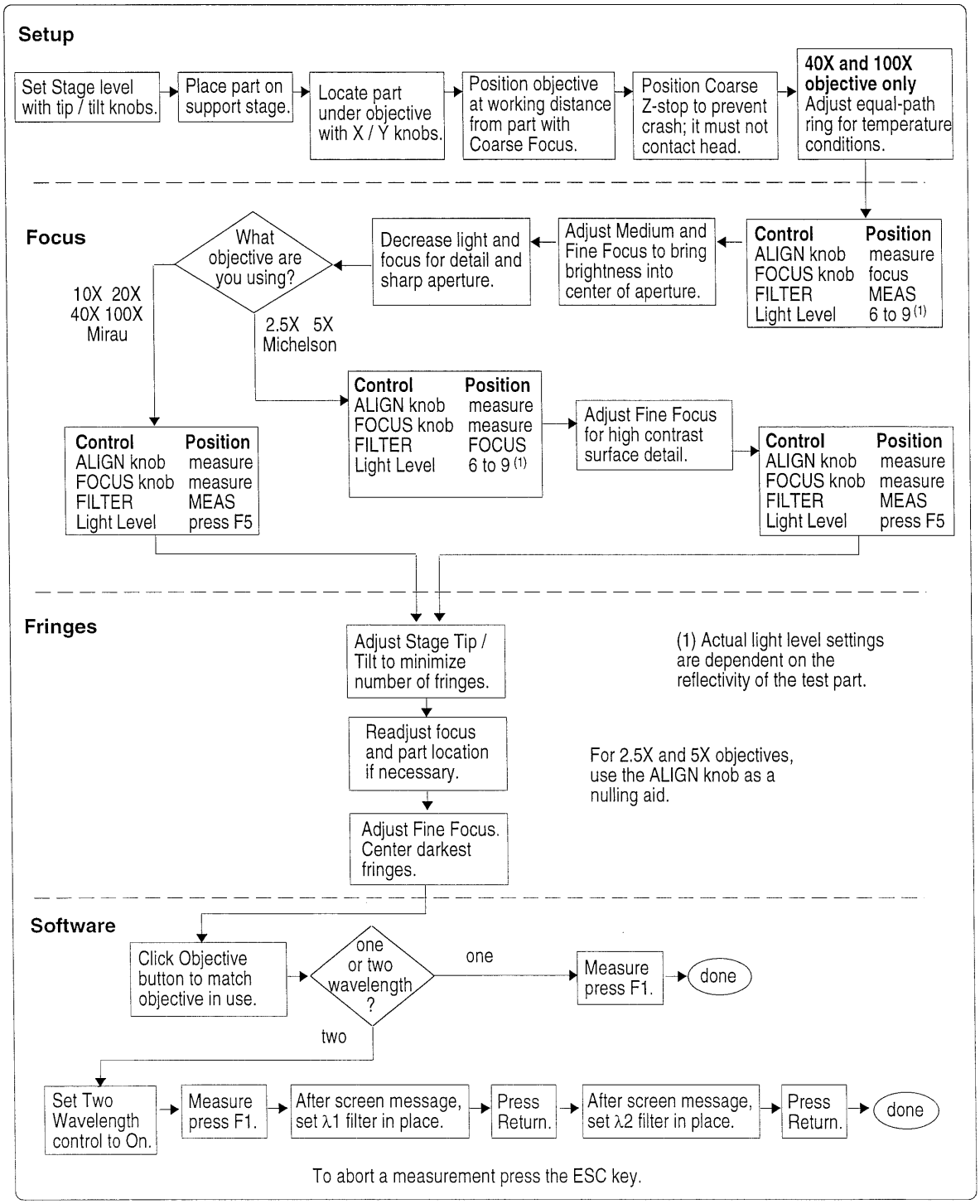
$$\lambda_s = \frac{\lambda_1 \lambda_2}{\lambda_1 - \lambda_2}$$

With the standard filter set, $\lambda_1 \approx 650$ nm and $\lambda_2 \approx 620$ nm. Hence, $\lambda_s \approx 14{,}433$ nm, or about 21 times greater than the single wavelength measurement.

When the wavelength fold option is off, the data is analyzed and displayed based on the synthetic wavelength. When the wavelength fold option is on, the synthetic wavelength is used to resolve the fringe order of the primary wavelength. Wavelength fold combines the measurement range of two wavelengths with the precision of a single wavelength.

MEASUREMENT FLOWCHART

The complete measurement process is detailed below.



Chapter 4
MAINTENANCE AND TROUBLESHOOTING

In This Chapter

GENERAL CARE

The components used in the Maxim•GP system will provide many years of service with little maintenance if a few simple guidelines are followed:

- *Keep Things Clean*
  The working environment should be as clean, dry, and as dust-free as possible. Occasionally clean painted surfaces and covers by wiping with a cloth dampened with a mild cleaning solution.
- *Handle Objectives Carefully*
  Objectives are precision optics. Handle objectives only when necessary. Keep unused objectives stored in their protective containers. Do not clean objectives unless you have experience cleaning optics.
- *Don't Take Things Apart*
  Do not attempt to dismantle optical parts or repair circuit boards since system performance may be impaired. Do not remove the Microscope head cover, there are no user-serviceable internal parts.
- *Contact Zygo*
  Call Zygo at (860) 347-8506, if you have questions or problems.

MAINTENANCE AND SERVICE FOR HP COMPONENTS

Refer to the HP documentation for maintenance information for the HP components, which include the System Processor, Color Display, Mouse, Keyboard, and any HP accessories, such as the DeskJet printer.

If you require service or assistance for the HP components contact Hewlett-Packard directly. In the United States, you can telephone HP toll free at (800) 835-4747. For other countries, refer to the directory sent with your product.

If you are experiencing problems, but are not sure what is at fault, contact Zygo.

MAINTENANCE AND SERVICE FOR THE MAXIM•GP

Maxim•GP components require minimal upkeep. Maintenance items are listed in the following table. For details, refer to the sections that follow the table. Recommended spare parts are listed in Table 4-2.

Maintenance	*Frequency*
Clean exterior surfaces of equipment.	As needed, based on the operating environment.
Change and align lamp bulb.	As needed, when bulb expires.
Clean objectives or filters.	As needed; only when dirty.
Lubricate the Microscope column.	Every two months.
Replace Electronic Enclosure fuse.	As needed, when fuse blows.

Maintenance Schedule
Table 4-1

Component	*Description*	*Zygo Part Number*
Lamp Bulb	BRL 12V - 50W Halogen Bulb	1445-400-042
Fuse	250V 2A Fuse for Electronic Enclosure	1343-000-026

Recommended Spare Parts
Table 4-2

Cleaning of External Surfaces

Occasionally clean the painted surfaces of the equipment and covers by wiping with a cloth dampened, but not wet, with a mild cleaning solution.

Changing and Aligning the Lamp Bulb

Complete the following procedure and refer to Figure 4-1.

1. Turn off power and disconnect the lamp housing cable from the Electronic Enclosure.

   WARNING!

   Allow the lamp housing and the lamp bulb to cool before continuing.

2. Remove the lockscrew and pull the socket sleeve from the lamp housing.

   WARNING!

   Do not touch the glass part of the lamp bulb with bare hands. Touching the bulb may cause premature bulb failure.

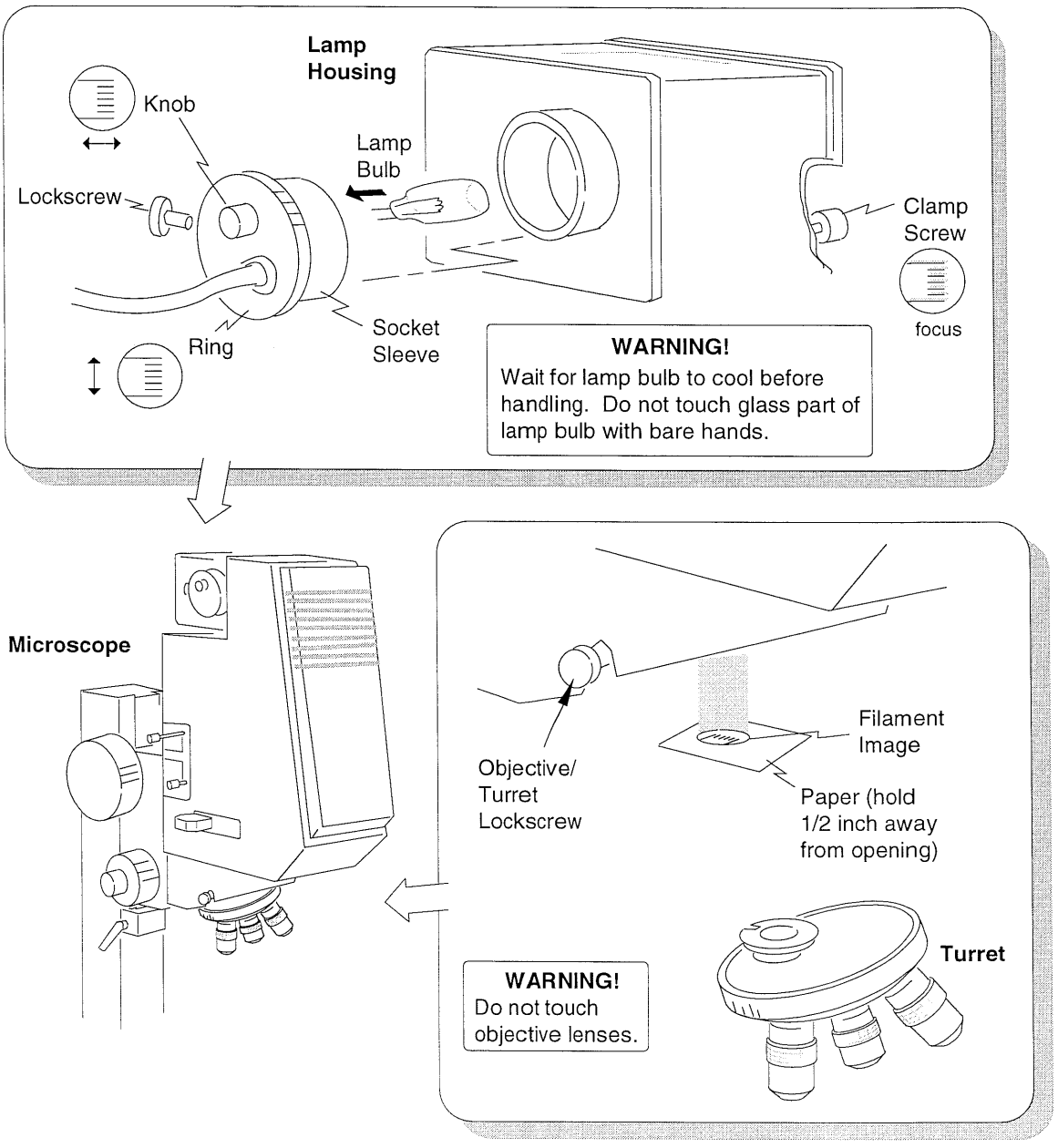
3. Remove the old lamp bulb from the socket sleeve.
4. Insert the new lamp bulb, aligning the pins to the holes on the socket.
5. Reinstall the socket sleeve and lockscrew. Connect the lamp housing cable to the Electronic Enclosure and turn on power.
6. Position the FOCUS and ALIGN knobs, and the filter tray, in the measure position.

   WARNING!

   Do not touch the glass surfaces of the objective.

7. Loosen the objective/turret lockscrew and remove the turret or objective.
8. Position a small piece of paper under the Microscope head, and about 1/2 inch away.
9. Adjust the light intensity of the Microscope until a filament image is observed on the paper.
10. Adjust the filament image for best focus by loosening the clamp screw and moving the lamp housing up and down. When best focus is achieved, tighten the clamp screw.

11. Center the filament image from front to back by loosening the lockscrew and rotating the ring. When centered, tighten the lockscrew.
12. Center the filament image from side to side by turning the socket sleeve knob.
13. Reinstall the turret or objective; secure it with the objective lockscrew.



Changing and Aligning the Lamp Bulb

Figure 4-1

Cleaning Optics

Cleaning of any precision optic risks degrading the surface. All the cleanable objective lens surfaces are coated. Coated optics are easily damaged by improper or unnecessary cleaning. The need for cleaning can be minimized by proper handling techniques, returning the objectives to their plastic case when not in use, and by keeping the environment clean.

Do not attempt to clean optics within the Microscope head since system performance may be impaired.

Recommended Cleaning Materials:

- *Polyethylene lab gloves*
  Wear to prevent contamination of surfaces and protect the skin against harsh chemicals.
- *Compressed gas with blower nozzle*
  Use to blow off dust and lint from the optic.
- *Lens tissue*
  Use when it is necessary to clean an optical surface. The lens tissue should be optics grade.
- *Cotton swabs*
  Use to clean difficult to reach surfaces. The swabs should have wood or paper stems; plastic stems can dissolve in acetone.
- *Solvents*
  Use spectroscopic grade isopropyl alcohol and methanol to remove contaminates fixed to the optical surface. Use a mild, neutral 1% soap solution or lens cleaner to remove oily contaminates.

Many of these materials are available from:

Edmund Scientific Co.
101 East Gloucester Pike
Barrington, New Jersey, USA 08007
Telephone: (609) 573-6250

Recommended Cleaning Procedures:

WARNING!

Be careful when using isopropyl alcohol and methanol; both are flammable and toxic.

Do not reuse any cleaning tissue or pads, reusing tissues can cause contamination and damage to the optic.

Before cleaning optics, remove all rings and jewelry from your hands and wrists; wash your hands thoroughly to remove excess skin oils; and put on lab gloves.

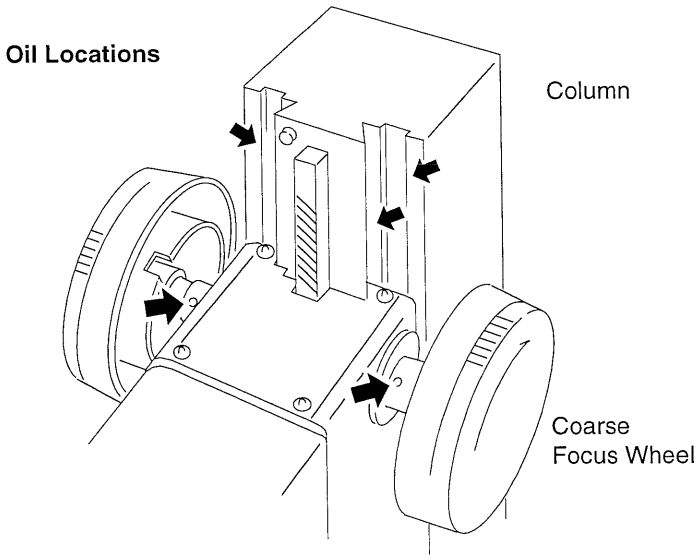
Contaminant	*Procedure*
Dust or light dirt	1. Blow off loose particles. 2. If any dust remains, twist two sheets of lens tissue around a swab or fold a lens tissue so it is just wider than the area you are cleaning. 3. Dampen the tissue with alcohol or methanol. 4. Wipe the lens straight across once. If it needs wiped again use a new swab or tissue.
Fingerprints, oil and water spots *Note: Clean surface immediately; skin acids attack lens coatings.*	1. Blow off loose particles. 2. Twist two sheets of lens tissue around a swab or fold a lens tissue so it is just wider than the area you are cleaning. 3. Dampen it with 1% soap solution. 4. Wipe the lens straight across once. If it needs wiped again use a new swab or tissue. 5. Repeat steps 2 and 4 with tissue dampened with distilled water to remove soap residue. 6. Repeat steps 2 and 4 with tissue dampened with alcohol or methanol.

Optics Cleaning Procedures

Table 4-3

Lubricating the Microscope Column

Every two months, apply a couple of drops of light-weight, non-migratory lubricating oil in the oil hole for each coarse focus wheel and to the column sliding surfaces. See Figure 4-2. A supply of oil is included with the column.

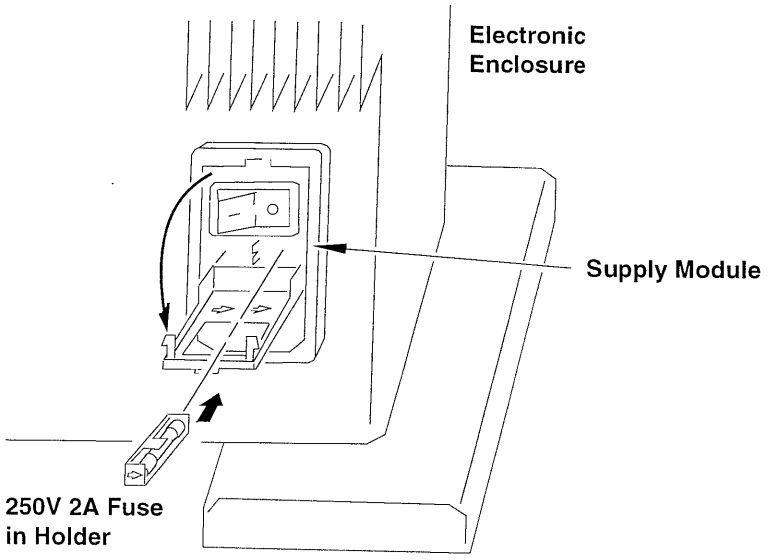


Lubricating the Microscope Column
Figure 4-2

Replacing the Fuse in the Electronic Enclosure

If it is necessary to check or replace the fuse in the Electronic Enclosure, refer to the procedure below and to Figure 4-3.

1. Turn off power.
2. Remove the power cord.
3. Open the supply module door.
4. Pull out the fuse holder and remove the fuse.
5. Place a new 250V 2A fuse into the holder. Then insert the holder, with the arrows aligned, into the supply module.
6. Close the supply module door and connect the power cord.



Replacing the Electronic Enclosure Fuse
Figure 4-3

GETTING HELP

If difficulties arise, please refer to the provided manuals. They are designed to help you through the most common questions. If you still have questions or need assistance, contact the Zygo Service Department directly.

Preparing for Technical Support

Before communicating with our Service Department, please have the following information *written down* so that we can provide you with the quickest possible solution to your problem.

- The equipment's model number and serial number. If it is software related, the software version number.
- A description of the problem and the sequence of events that led up to your discovering the problem. Note any software error messages.
- Your company name and complete shipping address.

Contacting Zygo

PHONE

(860) 347-8506, 8:00 a.m. to 8:00 p.m. (Eastern Time), Monday - Friday

Call from a telephone close to the system, in case the service engineer wants you to perform certain operations or requests additional information.

FAX

(860) 347-3968, 24 hours per day

WRITE

We welcome your letters. You can reach us at:

Zygo Corporation
Laurel Brook Road P.O. Box 448
Middlefield, Connecticut USA 06455-0448

RETURNING EQUIPMENT TO ZYGO

If it is necessary to return equipment to Zygo for service, please follow the procedure outlined below. You must first contact Zygo to obtain a **Return Authorization** (RA) number; so that we can route your equipment properly when it arrives. Equipment returned without an RA number is not accepted.

Note:

Do *not* return equipment to Zygo without an RA number.

1. Have the following information ready when requesting an RA number:
   - The name of the component and serial number if applicable.
   - Your company's name and complete shipping address.
   - A description of the problem and the sequence of events that led up to your discovering the problem.
2. Contact Zygo by telephone at (860) 347-8506.
3. We will provide an RA number and advise you of the next steps to take.
4. Pack the equipment securely to prevent any damage in shipping. Use the original shipping container and packing material when possible. Include the RA number on the shipping container and on any correspondence.

PACKING AND SHIPPING SUGGESTIONS

If it is neccessary to move or ship any component, adhere to the suggestions below. Contact Zygo if you need assistance or have questions.

WARNING!

To prevent damage, remove the objective from the microscope when moving equipment.

- Padding - If original packing material is not available, wrap equipment with bubble-wrap or similar padding for protection.
- Microscope - Disassemble the microscope to prevent breakage. Remove the objective, the turret, and the head from the column. Pack objectives, the turret, and the microscope head separately. Reinstall the shipping plug in the objective dovetail mount to protect the internal optics.
- Objectives - Secure objectives in their protective containers.
- System Processor - If the Matrox Board is held in place with a plastic mounting bracket, as shown in Chapter 2, it is *not* necessary to remove the board before shipping. Otherwise, remove the Matrox Board first to prevent damage.

TROUBLESHOOTING GUIDE

The following table can be used to quickly determine the probable cause for your trouble; it also lists the corrective action.

Problem	Possible Cause	Solution
No power.	Equipment not plugged in.	Check power strip and cords.
	Enclosure switch off.	Turn switch on.
	Blown Enclosure fuse.	Replace fuse.
	Disconnected or loose cables.	Check cable connections.
	Defective incoming power.	Check power source.
	Defective Electronic Enclosure.	Call Zygo.
Enclosure blows fuse.	Defective incoming power.	Check power source.
	Circuit overload.	Plug system into its own circuit.
No light.	Filter tray not set at detent.	Check filter position.
	Defective objective.	Try another objective.
	Loss of power.	See "No power".
	Defective lamp bulb.	Replace bulb (Chapter 4).
	Light level control adjusted low.	Adjust light level.
	Defective Electronic Enclosure.	Call Zygo.
No video image.	Video Monitor disconnected.	Check Video Monitor connections.
	Video Monitor turned off.	Turn Video Monitor switch on.
	Video Monitor controls set wrong.	Adjust Brightness and Contrast.
	Part way out of focus.	Adjust focus.
	No light.	See "No light".
	Computer crash or hang-up.	Restart computer.

Problem	Possible Cause	Solution
Video image is spotty or partial.	Part way out of focus.	Adjust focus.
	Incorrect part tip/tilt.	Adjust Stage tip and tilt knobs.
	Filter tray not set at detent.	Check filter position.
	Part is too rough or irregular.	Check system with known good part.
	Focus knob in light path.	Put focus knob in proper position.
	Dirty objective.	Clean objective or try another objective.
	Video Monitor controls set wrong.	Adjust Brightness and Contrast.
	Internal Microscope head optics are dirty.	Call Zygo.
Can't obtain an interference or fringe pattern.	Part out of focus.	Adjust focus.
	Incorrect part tip/tilt.	Adjust Stage tip tilt knobs.
	Part has low reflectivity. Part too rough.	Check system with known good part.
	Support stage improperly aligned.	Align support stage.
	Focus filter not used.	Use focus filter to assist with focusing of 2.5X and 5X objectives.
	Beam block blocking reference path (2.5X and 5X objectives only).	Push the beam block in.
Image shifts when adjusting tip/tilt.	Part surface is vertically offset from ideal location.	Locate part surface at ideal height above the X-Y stage (Chapter 2).
Focus shifts when adjusting tip/tilt.	Support stage is not laterally aligned under objective.	Realign Support Stage (Chapter 2).
Part hard to focus.	Part has low reflectivity.	Focus first with high power objective.
	Part is extremely smooth.	Focus first with high power objective.
	Part too rough.	Check system with known good part.

Problem	Possible Cause	Solution
Features on part appear to move when focusing.	Improperly aligned lamp bulb.	Align bulb (Chapter 2).
Microscope head does not move.	Head contacting Coarse Z-stop.	Move Coarse Z-stop.
	Head at end of travel.	Relocate head with Focus controls.
Inconsistent measurement results.	Part out of focus.	Adjust focus.
	Part not secure.	Use fixture to secure part.
	Incorrect part tip tilt.	Adjust Stage tip and tilt knobs.
	Dirty part.	Clean part.
	Dirty objective.	Clean objective or try another objective.
	Excessive vibration.	Check fringe stability. Check vibration isolation system.
	Objective switched after making system error file.	Make new error file. (Error files are objective specific.)
Software error message - "Cannot keep up with frame grabber".	Using high resolution camera mode with HP 715/33.	Make an acquisition mask smaller than the camera image area.
	Reconfiguring or building application fragments memory.	Press the Measure button again.
	System Processor performing background functions, like printing.	Wait for the function to end.
	Window size too large for scan length and Camera Res selected.	Make an acquisition mask smaller than the camera image area.
Instrument cannot be initialized when MetroPro starts.	Instrument not turned on.	Turn on power switch on Electronic Enclosure.
	Defective cable or connector between instrument and HP System Processor.	Check and replace cables.
	Improperly connected cables.	Ensure that the RS-232 cable is connected to the right port on the HP System Processor.
	Matrox Board not properly seated in the HP System Processor.	Reseat Matrox Board (Chapter 2).

Appendix A
WHERE TO FIND THINGS

This manual, OMP-0349, covers installing, using, and maintaining the Zygo Maxim•GP.

Manual Contents

Chapter 1..... A quick system overview and detailed specifications on the microscope components.

Chapter 2..... Putting the pieces together and connecting the wires.

Chapter 3..... Basic operation, instrument controls, focusing, and helpful hints. Using the MetroPro software.

Chapter 4..... Maintenance, troubleshooting, and technical support.

Zygo Software Manual References

OMP	*Manual*	*Description*
0346	Getting Started With MetroPro	Introductory information for MetroPro version 4.0.0 and later.
0347	MetroPro Reference Guide	Reference material for MetroPro version 4.0.0 and later.
-	Application manuals	Various small, compact booklets dealing with one unique application. Contact Zygo for the latest listing.

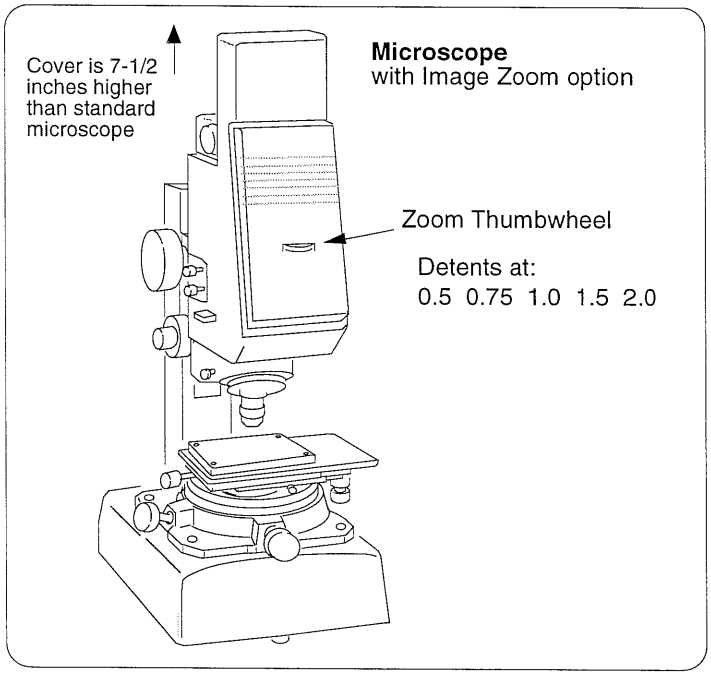
Other Sources of Information

Item	*Where to Find Information*
HP components: System Processor, Color Display, keyboard, mouse, etc.	Documentation supplied by Hewlett-Packard.
HP-UX	See manuals supplied by HP: *Using HP-UX* *HP Visual User Environment User's Guide*
TMC Vibration Isolation Table	Documentation supplied by Technical Manufacturing Corporation.

Appendix B

MICROSCOPE IMAGE ZOOM OPTION

The Microscope Image Zoom Option provides continuous variable zoom from 0.5 to 2.0 times the magnification of the objective in use. The zoom option changes the field of view of all the objectives by adding specialized optics inside the Microscope head. The Microscope head cover is enlarged to house the specialized optics; the zoom setting is changed by turning a thumbwheel on the front of the instrument.



This option is available for the Zygo NewView 100 and the Maxim•GP microscopes. It is a factory installed option, available with the original system order, or added later, if the system is returned to Zygo. An Image Zoom Option system operates similar to the standard Microscope. The information in this appendix applies only to systems with this option.

Note:

The functional performance of a zoomed objective will not be equal to a corresponding nonzoomed objective. For example, a 5X objective at 2X zoom is not the same as a 10X objective.

The 0.5 zoom setting may cause image artifacts. When using the 10X, 20X, 40X, and 100X objectives, the reference surface might be off center limiting the useful field of view.

Objective Specifications

(Nominal specifications at 1X zoom)

Power	Sys Mag	NA	Work Dist (mm)	Focus Depth (μm)	Inter Depth (μm)	Lat Res (μm)	Field of View H x V (mm)	Spatial Samp (μm) Lo	Spatial Samp (μm) Std	Slope (deg) Lo	Slope (deg) Std
2.5X	50X	0.075	11.1	185.0	40	4.87	2.82 x 2.11	8.80	4.40	1.0	2.0
5X	100X	0.1	9.0	70.0	40	3.65	1.41 x 1.06	4.40	2.10	2.0	4.1
10X	200X	0.25	4.0	10.0	20	1.46	0.70 x 0.53	2.20	1.10	4.1	8.1
20X	400X	0.4	2.5	3.5	7.0	0.91	0.35 x 0.26	1.10	0.55	8.1	15.9
40X	800X	0.5	4.5	1.8	3.6	0.73	0.18 x 0.13	0.55	0.28	15.9	22.3
100X	2000X	0.8	0.6	0.6	1.2	0.46	0.070 x 0.053	0.22	0.11	33.3	33.3

Objective Specifications at Other Zoom Settings

Specifications for the objectives at the various zoom settings are easily calculated. Use the multipliers in the table below for the listed specification; multiply times the value shown for that objective at 1X zoom. 2.5X objective specifications at different zoom settings are shown in the next chart as an example. Note that NA, Work Dist, Focus Depth, Inter Depth, and Lat Res do not change.

Zoom Setting	0.5	0.75	1.0	1.5	2.0
Multiplier for Sys Mag and Slope	0.5	0.75	1.0	1.5	2.0
Multiplier for Field of View and Spatial Samp	2.0	1.333	1.0	0.667	0.5

2.5X Objective Specifications at Different Zoom Settings

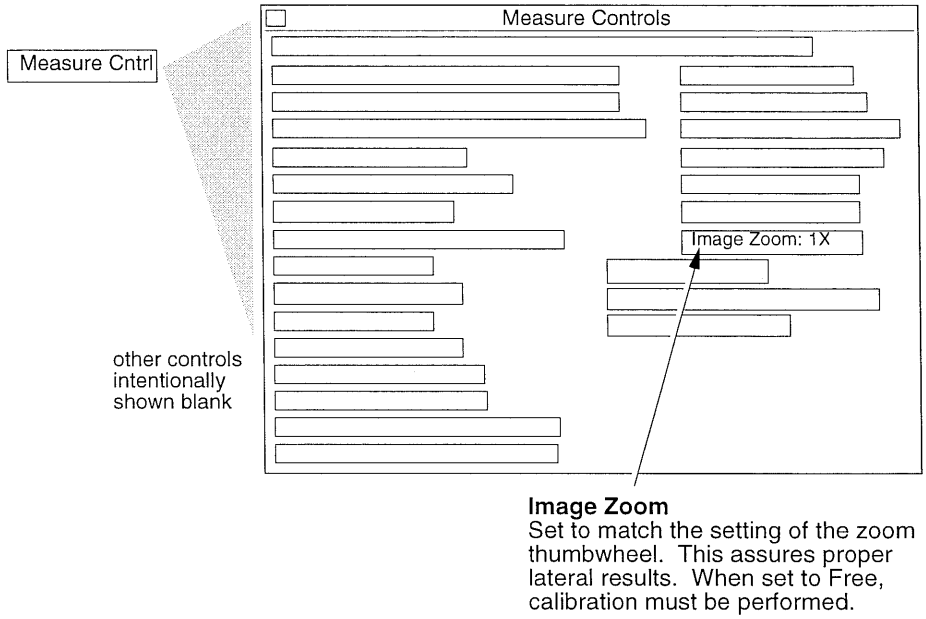
Zoom	Sys Mag	NA	Work Dist (mm)	Focus Depth (μm)	Inter Depth (μm)	Lat Res (μm)	Field of View H x V (mm)	Spatial Samp (μm) Lo	Spatial Samp (μm) Std	Slope (deg) Lo	Slope (deg) Std
0.5	25X	0.075	11.1	185.0	40	4.87	5.64 x 4.22	17.60	8.80	0.5	1.0
0.75	38X	0.075	11.1	185.0	40	4.87	3.76 x 2.81	11.73	5.87	0.8	1.5
1.0	50X	0.075	11.1	185.0	40	4.87	2.82 x 2.11	8.80	4.40	1.0	2.0
1.5	75X	0.075	11.1	185.0	40	4.87	1.88 x 1.41	5.87	2.93	1.5	3.0
2.0	100X	0.075	11.1	185.0	40	4.87	1.41 x 1.06	4.40	2.20	2.0	4.0

Objective Specification Notes:

Power .....Magnifying power of the objective.
Sys Mag.....System magnification, the enlargement of the surface as viewed on the Video Monitor.
NA.....Numerical aperture, a number representing the resolving power of the objective.
Work Dist.....The working distance from the end of the objective to the test surface when focused.
Focus Depth.....Vertical distance within which any specimen detail will simultaneously be in focus.
Inter Depth.....Interference depth, vertical distance over which interference can occur; with 10 nm filter.
Lat Res .....Lateral resolution, optical resolution of the imaging system.
Field of View.....The size of area imaged and measured.
Spatial Samp .....Spatial sampling, the apparent pixel size at each magnification.
Slope.....Maximum angle of surface feature from one pixel to the next that can be measured.
Lo Std .....Camera size in pixels: Lo is 320 x 240 pixels, Std is 640 x 480 pixels.

Software Calibration for the Image Zoom Option

Calibration establishes the lateral measurement resolution of each camera pixel. The Image Zoom control *must* be set in the Measure Controls window to match the zoom setting selected on the thumbwheel. If the setting of the control and the thumbwheel do not match, results will be erroneous. Select Free with the Image Zoom control when the thumbwheel is set between detent positions.



Calibrating for "Free" Zoom

Each time the Image Zoom control is set to Free, you must perform calibration to provide absolute units of measure. Calibration *must* be performed before making measurements. A calibration standard, such as the Zygo Model 5690 Lateral Calibration Standard, makes calibration easier and more accurate.

For more information on calibration, see "Calibration - Microscope" in the *MetroPro Reference Guide, OMP-0347*. An overview of the calibration procedure is provided on the following page.

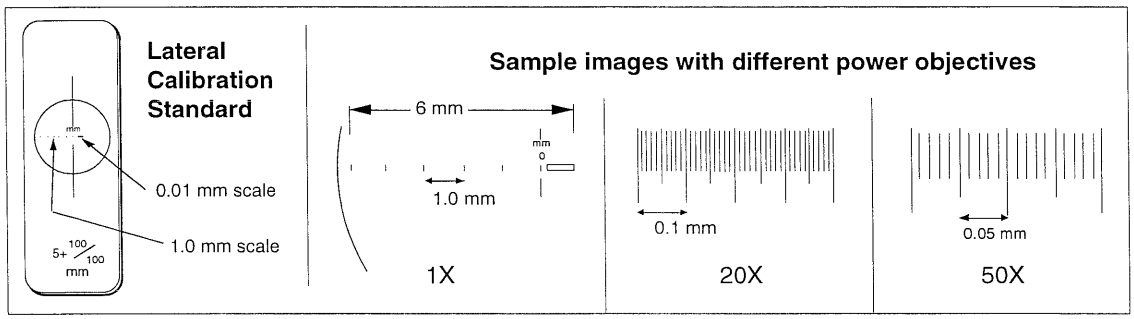
Calibration Procedure

Note:

Calibration settings for Free are not saved. Calibration must be performed every time the instrument is restarted.

Calibration performed when the Microscope thumbwheel is not at a detent is only temporary. If the the thumbwheel is moved to another free position, the Microscope must be recalibrated.

1. Position the Lateral Calibration Standard under the objective. Focus the instrument on the standard's lines and null the fringe pattern.

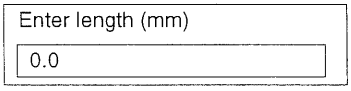


2. Click the **Calibrate** button to open the Lateral Calibrator window.

3. Select the objective to calibrate by clicking on the little box to the left of its title.

4. Draw a line across the image. Position the crosshairs over the image and click and hold the left mouse button; move the mouse to draw a line parallel to the Standard's scale; and release the mouse button for the end point.

5. Using the keyboard, enter the length of the drawn line in millimeters, as determined by reading the Calibration Standard scale. Press Return when done.



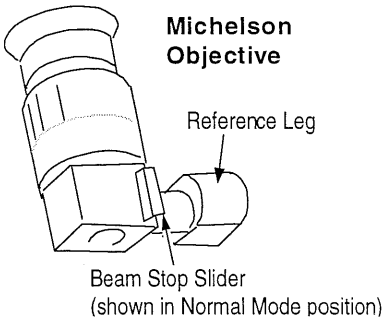
6. Close the Lateral Calibrator window and make your measurement.

Appendix C

2.5X AND 5X MICHELSON OBJECTIVE USER INSTRUCTIONS

Using Michelson Objectives

The Michelson objectives have a right-angle reference leg with a beam stop slider. For normal focusing and measuring, the beam stop slider *must* be all the way in. Pulling the beam stop slider out to the detent blocks a reference beam. The beam stop slider provides for two modes of operation - Normal or Focus Aid.

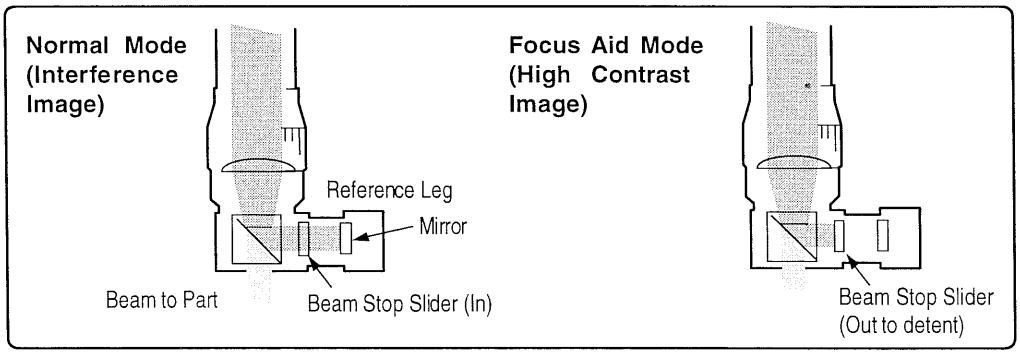


Note: If the beam stop slider is removed, dust may enter into the objective and impair its performance.

Normal Mode Beam stop slider IN. This permits a reference beam to reflect off an internal reference surface and provide an interference image with fringes. Fringes are required in order to measure.

Focus Aid Mode Beam stop slider OUT to detent. The reference beam is blocked from reaching the reference surface. This makes the instrument act like a standard microscope and enhances surface detail imaging. This serves as an advantage when focusing on a low reflective part or a part with little surface detail. After the part is in focus, push the beam stop slider back in before measuring.

Note: If fringes can not be obtained, check that the beam stop slider is in.



I

K

L

M