Mark II
Interferometer System, 4-inch
Operating Manual
OMP-0055G

April 1990

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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. An appropriate revision letter also appears at the bottom of each revised page.

Manual revision status and printing history appear below.

Revision	Publication Date
Original Issue	March 1980
Revision B	May 1980
Revision C	September 1980
Revision D	June 1983
Revision E	September 1983
Revision F	April 1986
Revision G	April 1990

NOTICE

This manual contains descriptions, drawings, and specifications for a Zygo product. Equipment or products made prior to or subsequent to the publication date of this manual may have parts, features, options, or configurations that are not covered by this manual.

Specifications contained herein are subject to change by Zygo Corporation without prior notice. Zygo is not responsible for errors or omissions that may be contained herein or for incidental or consequential damages in connection with the furnishing or use of this information.

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Zygo Corporation
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Attention: Technical Publications Department

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. In the case of new systems, the warranty period is 12 months. 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 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.

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Chapter 1
INTRODUCTION

The Zygo Mark II Interferometer System* is designed for measurement problems requiring high precision, noncontact, nondestructive evaluation of specular plano or spherical surfaces in reflection, or components or systems in transmission. The key modules in the Interferometer System consist of the Mark II Mainframe and the Video Monitor. An optional Model VP-2 Video Printer may also be added to provide hard-copy output. Each of the system modules is described in detail in this section.

MARK II MAINFRAME

The Mark II Mainframe is designed to acquire real-time interference patterns for evaluation by the user. The light source for the mainframe is a 632.8 nm HeNe laser with a circularly polarized output beam. Other functional components of the mainframe includes a laser power supply, beam diverger spatial filter (BDSF), CCTV camera, and a sealed optics compartment enclosing the more delicate optical components. An accessory receptacle is provided for mounting transmission elements, and a remote operator control box is connected to the mainframe by cable.

VIDEO MONITOR

This system module displays the real-time interference patterns acquired by the mainframe. The Video Monitor is mounted on a gimbal bracket, allowing the user to optimize the orientation of the 9-inch diagonal viewscreen. As required, the gimbal bracket may be placed on a tabletop, or on a specially-designed riser bracket which locates the monitor over the mainframe.

MODEL VP-2 VIDEO PRINTER

The VP-2 Video Printer provides a permanent record of the fringe patterns displayed by the mainframe, using a specially-coated paper.

- U.S. Patent No. 4,201,473

Chapter 2

SPECIFICATIONS

MARK II MAINFRAME

Aperture	4-INCH DIAMETER WITH CONTINUOUS ZOOM TO 2/3-INCH DIAMETER; I.E., 6X ZOOM RANGE
System Quality	λ/20 (632.8nm) for plano testing λ/10 for spherical testing
Light Source	632.8 nm HeNe laser with circularly polarized output beam. Field replaceable package
Alignment	Auto-Align and Quick Fringe Acquisition Systems
Viewing	Low distortion, 9-inch video monitor
Recording	Simultaneous fringe observation and photography using a Model VP-2 Video Printer (not included).
Sample Dimensions	Unrestricted
Dimensions	25-1/2" x 21" x 8" (L, W, H) (648 mm x 533 mm x 203 mm)
Weight	75 lbs. (34 kg.)
Video Connectors	BNC Type
Electrical Signal Outputs	Video, horizontal sync, and vertical sync
Video Output	520 lines/60 Hz, 2:1 Interlace, EIA RS170 Standard or, 625 lines/50 Hz, 2:1 Interlace, CCIR Standard
Electrical Power Requirements	115 ±10 VAC, 60Hz, 110 ±10 VAC, 50Hz, or 230 ±10 VAC, 50Hz 50 Watts, single phase without Monitor 85 Watts, single phase with Monitor

VIDEO MONITOR

Viewscreen Size	9-inch diagonal
Connectors	BNC type
Sync	Internal
Electrical Signal Inputs	Video. The video input permits either 75-ohm or high-impedance termination
Electrical Power Requirements	115 $\pm$ 10 VAC, 60Hz @ 300 mA
Dimensions	12-1/4" x 9" x 9-1/2" (L, W, H) (311 x 229 x 241 mm)
Weight	14 lbs.

Chapter 3

LASER RADIATION SAFETY INFORMATION

LASER SAFETY

The Mark II laser emits visible red light only. No harmful or invisible radiation is emitted.

The radiant output of the internal laser and of the instrument is low. The radiation emitted cannot burn or drill holes, even if a lens is to focus the light.

However, the laser light emitted by the Mark II should be treated with caution and common sense. It will not hurt your skin, but to protect your eyes, don't look directly into the laser beam or stare at its bright reflections.

The American National Standard for the Safe Use of Lasers (ANSI Z136.1--1980) classifies this laser product as Low Power - Class II (per Table A1), and provides reasonable and adequate guides for its safe use. The user and personnel responsible for the safe use of the Mark II in the user's organization should consult this ANSI standard. It is available from:

American National Standards Institute
1430 Broadway
New York, NY 10018

NCDRH REGULATIONS

Effective August 2, 1976, the National Center for Devices and Radiological Health (NCDRH) of the Food and Drug Administration has established regulations for laser products manufactured after August 1, 1976.

OUTPUT BEAM DATA

Emission Duration:	more than 0.25 second
Radiant Power:	less than one milliwatt (1/1000 watt)
Wavelength:	632.8 nanometers

USE OF CONTROLS STATEMENT

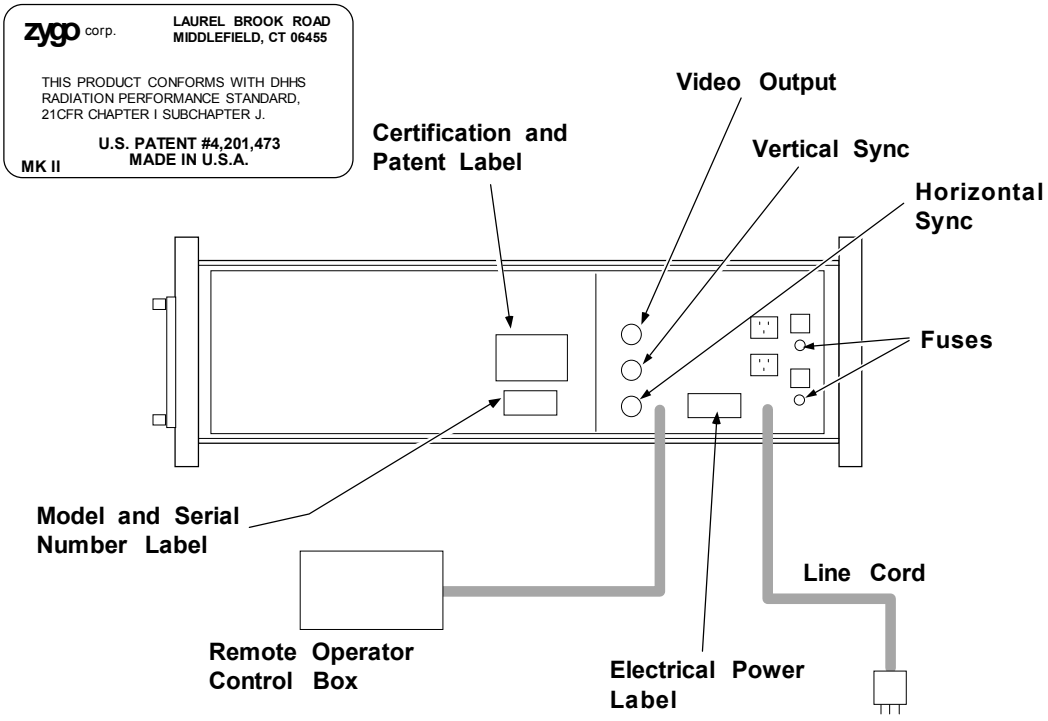
Federal Regulations require that the following statement be included in this manual.

WARNING:

Use of controls or adjustments, or performance of procedures other than those specified herein, may result in hazardous radiation exposure.

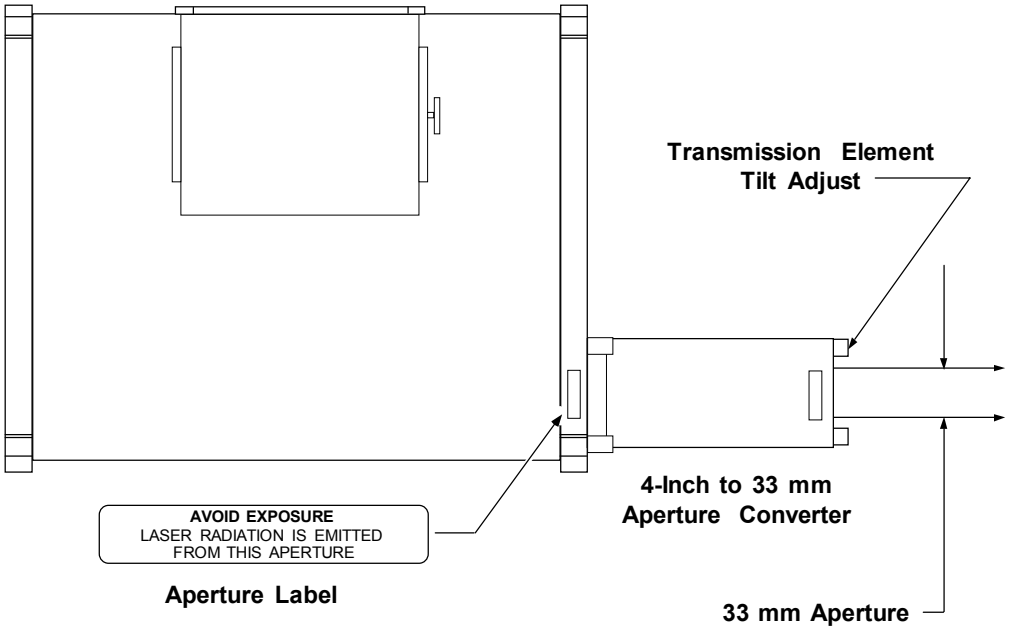
LABELS AND LABEL LOCATIONS

See Figures 3-1 through 3-3.



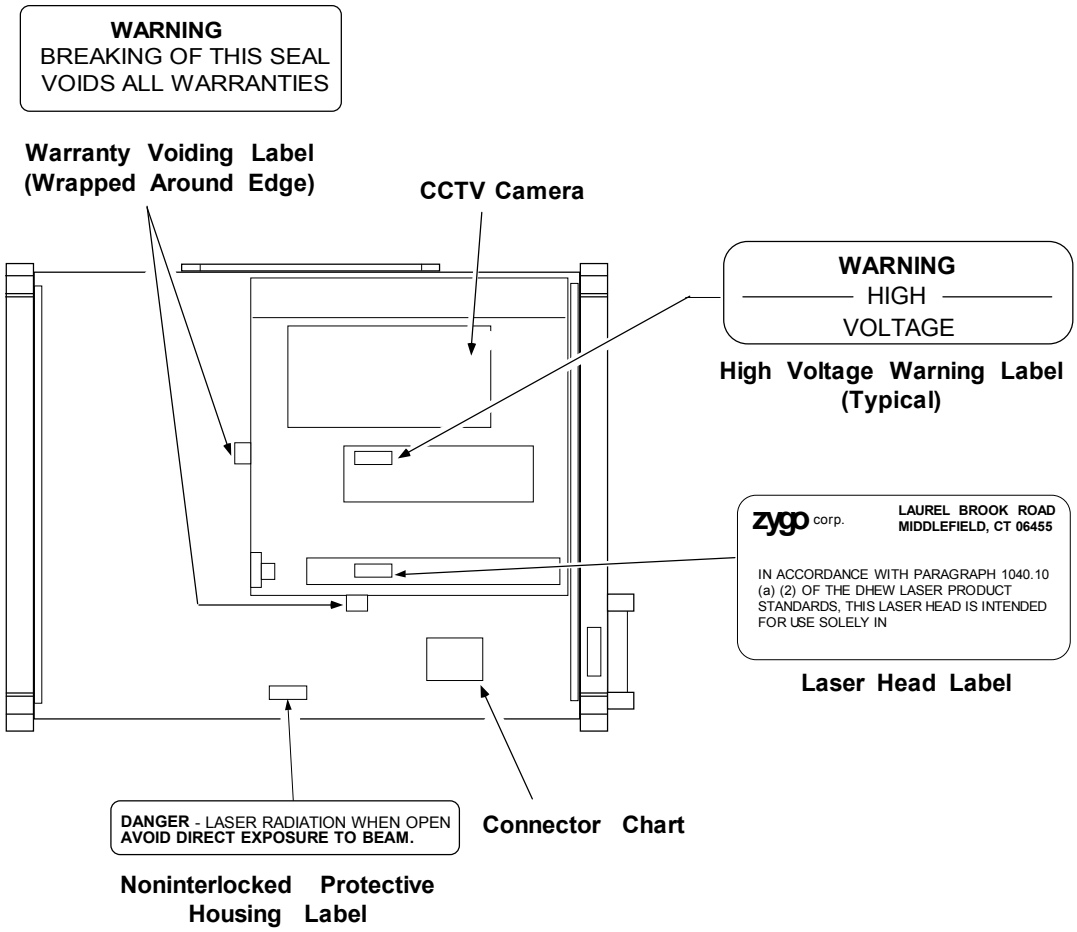
Mark II Mainframe - Rear View

Figure 3-1



Mark II Mainframe (Top View with Aperture Converter Installed)

Figure 3-2



Mark II Mainframe (Top View) with Cover Removed

Figure 3-3

ADDITIONAL INFORMATION

Emission Indicator

This green light is located on the front panel of the mainframe directly above the ON/OFF switch. When lit during operation, it indicates the Class II radiation is being omitted.

Beam Attenuator

This is an aluminum knob located on the front panel of the mainframe. It is marked **BEAM ATTEN**., and is a mechanical beam shutoff. Pull the knob OUT to shut off the laser beam. Push the knob IN to turn on the laser beam.

Replacement of Laser Heads and/or Laser Power Supplies

Use only ZYGO supplied laser heads and/or power supplies labeled for use in the Mark II. Install the replacement part following the specified procedure in the Mark II Service Manual, SP-0038. Follow the installation procedure exactly to ensure conformity to Federal Radiation Standards,

SUMMARY

The laser radiation emitted from the Mark II Mainframe will not damage eyes or skin provided you follow the usage guidelines established in this chapter.

ANSI provides additional information about the class of laser used in the Mark II. You can obtain this information by writing to ANSI at the address listed in this chapter.

Labels on the Mark II clearly identify apertures from which laser radiation is emitted.

Chapter 4

UNPACKING AND SETUP

MAINFRAME INSTALLATION CONSIDERATIONS

When maximum stability is desired, the Mark II Mainframe should be placed on an optical work table, such as a granite or honeycomb air table. Since the horizontal output beam exits from the right side of the instrument, the article under test and any auxiliary components may be conveniently placed on the same table, to permit measuring a variety of setups easily and quickly.

The Mark II Mainframe offers the user several options in the selection of an optimized measurement setup. In addition to the standard test setup, where the Mainframe is placed on an optical work table to provide a horizontal output beam, the Mainframe can also be mounted to provide a vertical output beam directed either up or down. With the remote control operator controls and the movable video monitor, the location of the Mainframe can be optimized quite independently from the test setup. This flexibility means that the Mark II Mainframe lends itself to laboratory and prototype use, as well as to production functions. The separability of the Mainframe and the external test setup means that one Mainframe can support numerous setups, either by the use of MUX cubes or by physically moving the Mainframe.

UNPACKING AND HANDLING

System Checklist

If any cartons have been damaged, contact the shipper at once. The shipping boxes for the Zygo Interferometer System should contain the following equipment and documentation:

- Mark II Mainframe
- Video Monitor with bracket
- Riser bracket and hardware, Video Monitor power cord, and a coaxial (BNC) cable
- Interferogram Interpretation & Evaluation Handbook, including Mechanical Parallelogram
- Acquisition Target
- Operation and Maintenance Manual (OMP-0055)
- Service Manual (SP-0038)

Removing Equipment from Boxes

1. Unpack the Mark II system in an area that is clean and dry. When removing the Mark II Mainframe, two persons (one at each end of the instrument) should grasp the underside of the unit and LIFT it out of the box. DO NOT PULL ON THE COVER of the unit. Carefully set the instrument down on a flat surface.
2. Check each shipping container to be sure you have removed all items. Do not discard the reusable shipping containers until it is certain that all items have been removed. It is recommended that you save the shipping containers in case you must return any equipment to Zygo.
3. Do not subject the Mainframe to harsh shocks. When moving system components from one location to another, use foam rubber or other shock absorbing material between the equipment and the container or transporter.
4. You are now ready to set up the system in the desired location.

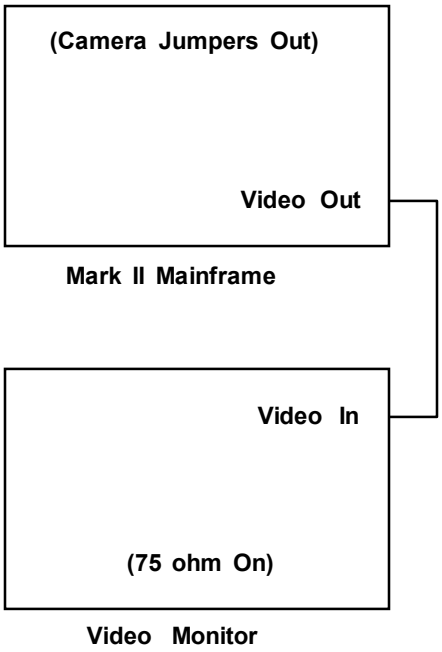
CONNECTIONS AND SWITCH SETTINGS

1. Secure all BNC cables to the appropriate receptacles. Figures 4-1 and 4-2 provide interconnection diagrams for the Video Monitor and Video Printer.

Note:

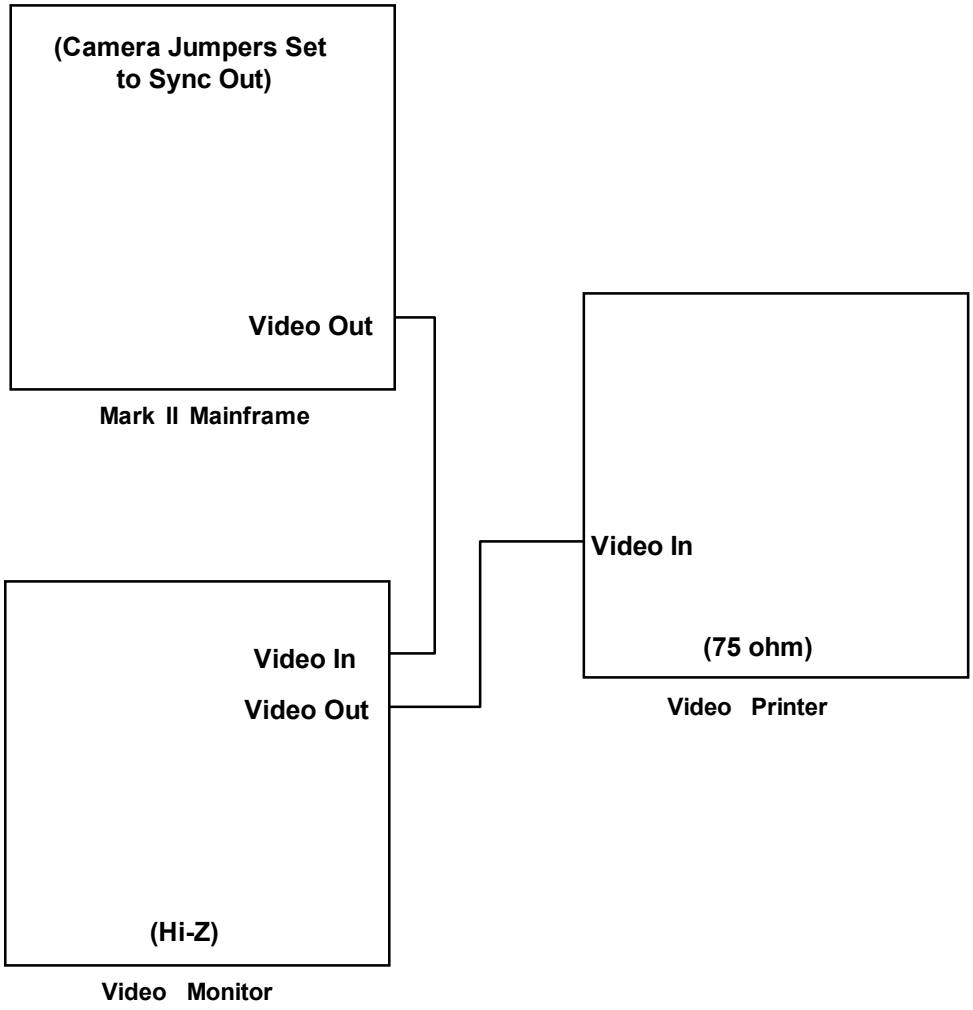
The CCTV Camera in the Mark II Mainframe has movable jumpers which allow selection of either incoming or outgoing sync signals. The Mark II will normally be set at the factory for outgoing sync, so the jumpers should not have to be moved.

2. Insert the male end of the Video Monitor power cord into either of the accessory outlets at the rear of the Mainframe.
3. Be sure that the 75Ω/HI-Z switch on the Video Monitor is in the proper position. (See Figures 4-1 and 4-2.)
4. The power cord for the Mainframe should be plugged into a power source as specified on the electrical power label on the back of the instrument. (Use of a 3-prong receptacle with a neutral ground lead is recommended.)



Mark II Mainframe with Video Monitor Interconnection

Figure 4-1



Mark II Mainframe with Video Monitor
and Video Printer Interconnection
Figure 4-2

Chapter 5

OPERATION

READ CHAPTER 3, LASER RADIATION SAFETY INFORMATION, BEFORE ATTEMPTING TO OPERATE THE MAINFRAME.

GENERAL INFORMATION

The Mark II Mainframe offers the user several options in the selection of an optimized measurement setup. In addition to the standard test setup, where the Mainframe is placed on an optical work table to provide a horizontal output beam, the Mainframe can also be mounted to provide a vertical output beam directed either up or down. With the remote control operator controls and the movable Video Monitor , the location of the Mainframe can be optimized quite independently from the test setup. This flexibility means that the Mark II Mainframe lends itself to laboratory and prototype use, as well as to production functions. The separability of the Mainframe and the external test setup means that one Mainframe can support numerous setups, either by the use of MUX cubes or by physically moving the Mainframe.

Before starting your Zygo Interferometer System, it is recommended that you familiarize yourself with the various controls and switches, as well as some general operating guidelines, as described below.

MAINFRAME CONTROLS AND SWITCHES

See Figures 5-1 through 5-3.

ON/OFF Toggle Switch

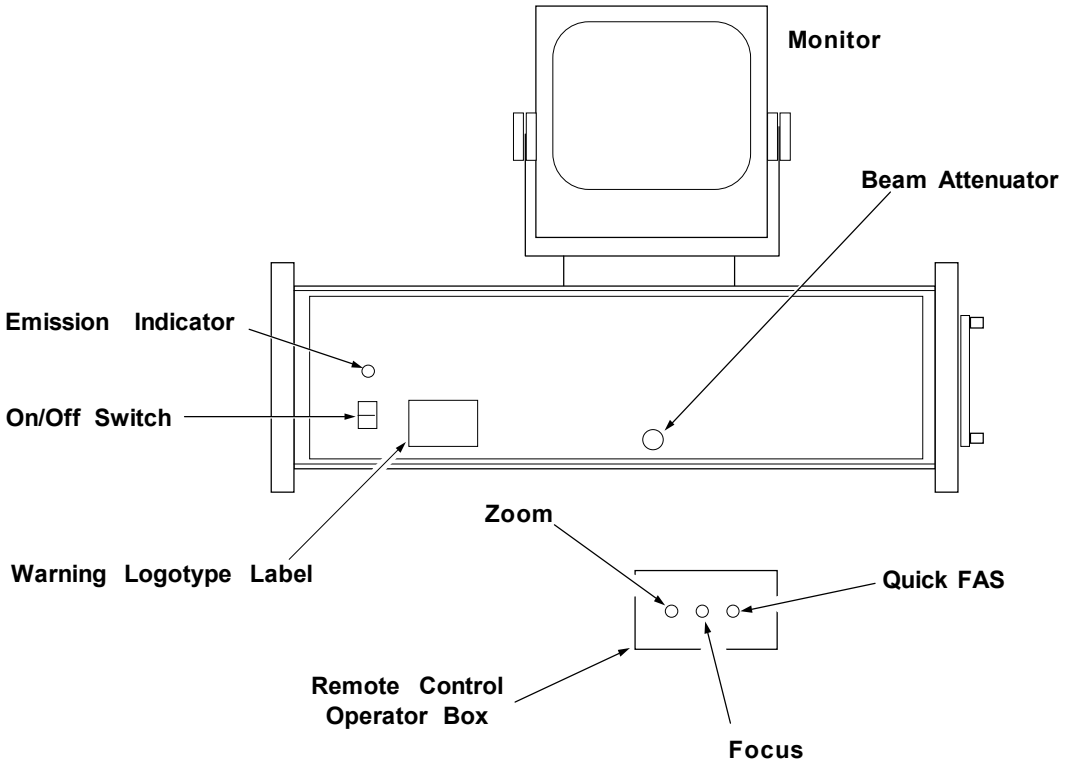
The ON/OFF toggle switch is used to turn the instrument on or off.

Beam Attenuator

Located on the front panel of the Mainframe is a knob which serves as a mechanical laser beam shut-off. Pulling the knob OUT shuts off access to all laser radiation. Pushing the knob IN returns the laser radiation.

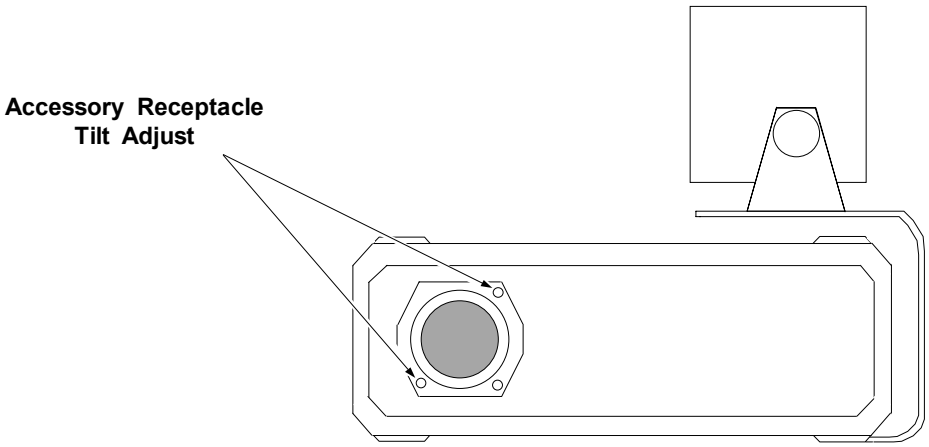
Accessory Receptacle Tilt Adjustments (Two)

These two knobs, located either on the Mainframe or on a remote accessory receptacle, permit adjustment of the tilt of the element in the accessory receptacle so that a transmission element can be aligned perpendicular to the output beam. When the Quick FAS Switch (described in the Remote Operator Control Box section) is in the ALIGN position, the two tilt adjustment knobs are used to superimpose the spot image of the transmission element and the center of the auto-align reticle as observed on the viewscreen.



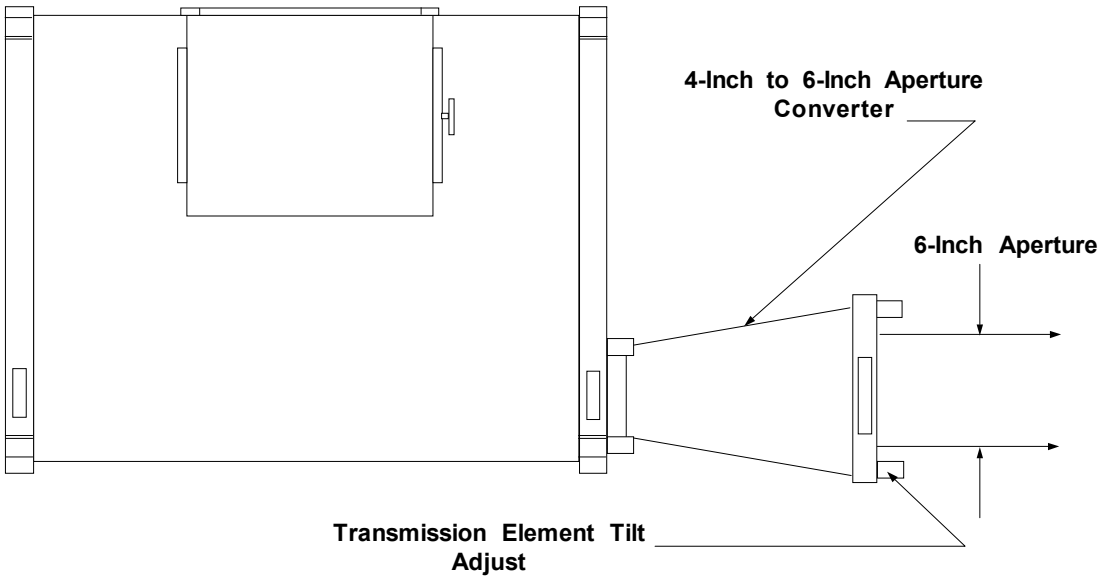
Mainframe Controls - Front View

Figure 5-1



Mainframe Controls - Side View

Figure 5-2



Mainframe - Top View (Typical)

Figure 5-3

REMOTE OPERATOR CONTROL BOX

See Figure 5-4.

Quick Fringe Acquisition System Switch (Quick FAS)

The center-off momentary switch has two actuating positions, **ALIGN** and **VIEW**. Pushing the switch momentarily to the left causes an alignment spot and auto-align reticle to appear on the Video Monitor viewscreen; pushing the switch momentarily to the right causes the interference pattern to appear on the Video Monitor viewscreen. It is necessary to hold the switch in either position approximately two seconds to properly complete the mode change.

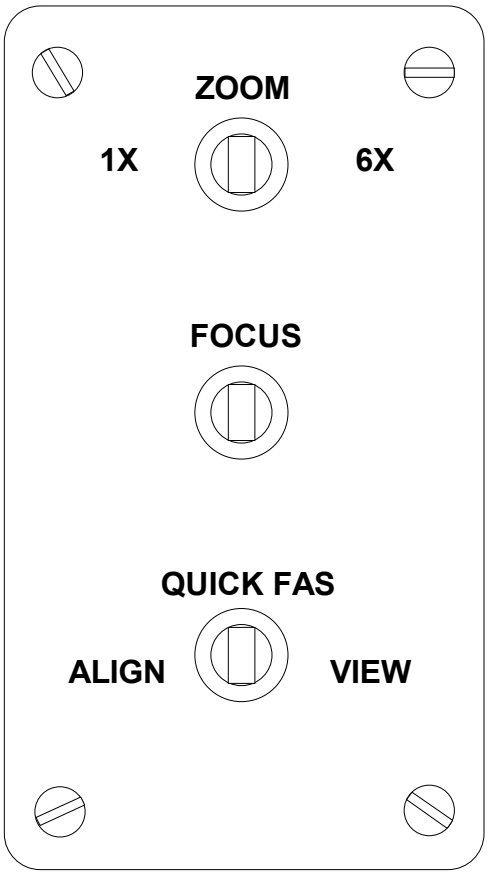
Zoom Adjustment Switch

This center-off momentary switch permits a continuous 6X magnification range of the aperture diameter for plano testing or the f/number for spherical or cylindrical testing.

Aperture Focus Switch

This center-off momentary switch permits the aperture of the article being measured to be brought into focus on the Video Monitor viewscreen. This is the most critical when working with small objects at or near the 6X zoom position. Focusing should only be attempted at or near 6X magnification. Hold the focus switch to either the right or the left while watching the monitor for the sharpest profile of either the edge of the object being measured or any small object (such as a pencil tip or card) inserted in the beam near the test object. When proper focus has been achieved, the fringes will be cut-off sharply at the edge, as opposed to being bent around it. Do not attempt to focus the fringes themselves (make them narrower or more well-defined) because their width depends upon illumination intensity and can only be varied by adjusting the Video Monitor controls for brightness and contrast.

There are cases with spherical or cylindrical accessories when the image of the aperture tested cannot be brought into sharp focus due to the nature of the image forming characteristics of those lenses. Under these conditions, bending of the fringes near the edge of the aperture can only be minimized using the above procedure.



Remote Operator Control Box
Figure 5-4

OPERATING THE SYSTEM

Startup

1. Be sure that the beam attenuator knob, located at the front of the instrument, is pushed IN.

2. Flip the power switch on the front panel to the ON position. The laser should start within 30 seconds. If it does not, refer to the Troubleshooting Section of the Service Manual (SP-0038).

Note:
A slo-blo fuse is conveniently located on the back of the instrument. See Chapter 6 for a fuse schedule

Operation Guidelines

1. Allow at least 30 minutes warmup time for the Mainframe and Video Monitor .
2. Never touch the glass surfaces of the optical accessories with your bare hands. If you do so, do not attempt to clean the surfaces unless experienced with optical cleaning techniques. Small dirty areas or grease can be tolerated to a point, but the soft coatings (90% reflectivity) cannot be safely cleaned; any attempt to clean a soft coating may do more harm than good. (See the section on Cleaning Optics in Chapter 6.)
3. When not using optical accessories, always put them back into their boxes.
4. When working with a mounted optical accessory, remember that any sudden move or slip when applying force to an object could result in a strained or broken element.
5. Do not overtighten screws clamping an optical accessory; pressure can distort the accurate reference surface.
6. The 2-axis mount, used to hold an optical accessory, utilizes a nylon finger and thumbscrew to clamp against the frame of the accessory. The pressure is very light, and, if the gimbal is tipped backwards, the optical accessory may fall out. Do not lift, tilt, or carry the 2-axis mount while it is holding an optical accessory.
7. The Mainframe is to be used on an axis which is defined by the auto-align system previously described. Proper adjustment in the align mode accomplishes this. If the alignment is not close enough, there may be no fringes visible in the fringe viewing mode.
8. To achieve the best fringe contrast, the intensities of the two interfering beams should be approximately equal.
9. Components resting on the surface plate should be reasonably close to the Mainframe to minimize wavefront distortions caused by an unstable air path. Keep the path length to the last reflector as short as possible.
10. To reduce wavefront distortion due to an unstable air path, keep the cavity length as small as possible.

INSTALLING A TRANSMISSION ELEMENT

The term transmission element here refers to a transmission flat or sphere. These instructions apply to both element types. The Aperture Converter installation instructions appear later in this chapter.

Handling a Transmission Element

Hold the element by the metal rim without touching the glass. When not in use, return the element to its protective container.

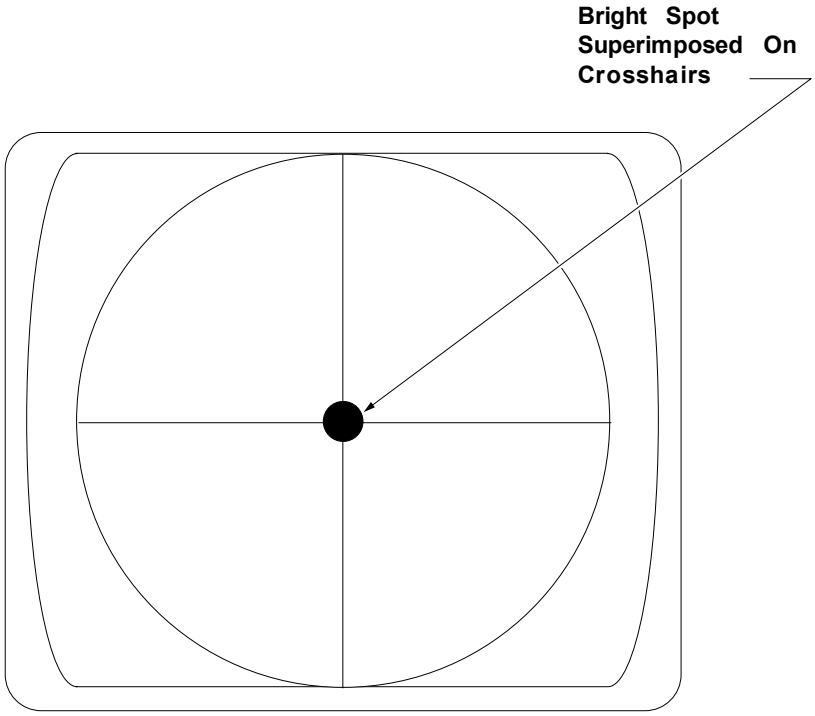
Installing the Element on the Accessory Receptacle

Refer to Figure 5-2 for the location of the Mark II Mainframe accessory receptacle.

1. Loosen the two screws on the bayonet spring clips to allow full travel of the clips.
2. Engage the two short, metal pins of the element in the slots on the accessory receptacle.
3. Push the element straight in, and turn it clockwise until you hear it click into place.
4. Tighten the two screws on the bayonet spring clips to secure the element in the accessory receptacle. You can now align the element. The following sections describe specific steps for Transmission Flats or Spheres.

ALIGNING A TRANSMISSION FLAT

1. Turn on the Mainframe. Flip the **QUICK FAS** switch on the Remote Control Operator Box (Figure 5-4) to the ALIGN position, and hold it there for about two seconds.
2. The alignment target (crosshairs) will appear on the fringe monitor. In addition to the crosshairs, there will be two bright spots displayed. The brighter of the spots represents the reflection off the uncoated surface of the transmission flat. Turn the two tip and tilt knobs on the accessory receptacle until the brighter spot is superimposed on the crosshairs center. Refer to Figure 5-5.
3. When the brighter spot is superimposed, the alignment is complete.



Bright Spot Superimposed on Crosshairs
Figure 5-5

ALIGNING A TRANSMISSION SPHERE

1. Flip the **QUICK FAS** switch on the Remote Operator Control Box (Figure 5-4) to the ALIGN position. Hold it there for approximately two seconds.
2. The alignment target (crosshairs) will appear on the fringe monitor. In addition to the crosshairs, one bright spot will be displayed. This spot represents the reflection off the surface of the transmission element. Turn the two tip and tilt knobs on the accessory receptacle (Figure 5-2) until the bright spot is superimposed on the crosshairs center (Figure 5-5).
3. Place the test item (or any 4% reflectivity concave or convex surface) at the focus of the convergent beam from the transmission element.
4. Move the test part so that its center of curvature coincides with the focal point of the transmission sphere. A bright dot will converge on the center of the crosshair and will disappear behind it.

5. With the **QUICK FAS** switch in the VIEW position, there will be a bull's-eye pattern on the monitor. If the pattern is not in the center of the monitor screen, use the X and Y axis adjustment knobs on the three or five axis mount to center it. Do NOT move the tilt adjustments knobs on the Mainframe itself.
6. Once you have centered the pattern and it fills the screen, focus the test item. Lightly push on the back of the mount and observe the direction in which the rings move.
7. If the rings move toward the bull's-eye center, turn the Z adjustment knob on the mount clockwise until the fringes are straight. If the rings move out (away from the bull's-eye center), move the Z adjustment knob on the mount counterclockwise until the fringes are straight.
8. To adjust the position and number of fringes, turn the X and Y adjustment knobs on the receptacle end of the transmission element. For optimum performance, there should be zero to seven fringes displayed on the fringe monitor at best focus.

INSTALLING AND ALIGNING AN APERTURE CONVERTER

1. Remove any transmission element installed in the Mark II Mainframe accessory receptacle.
2. Place a plano reflector (either a reference or transmission flat) mounted on a two-axis mount in the laser beam path. Position the mount approximately 18 inches from the Mainframe .
3. Flip the **QUICK FAS** switch to the ALIGN position and hold in place for approximately two seconds.
4. Align the plano reflector using the "Aligning a Transmission Flat" procedure. This alignment must be preserved for the remainder of the procedure.
5. Remove any transmission element that may be installed on the Aperture Converter.
6. Engage the two short, metal pins on the converter in the slots on the Mainframe accessory receptacle.
7. Push the converter straight in, and turn it clockwise until it clicks into place. Tighten the small, locking screw on the converter.
8. Use the Mainframe accessory receptacle tip and tilt knobs to align the converter.
9. Once the converter is aligned, remove the plano reflector from the setup.
10. Insert the transmission element in the Aperture Converter.

11. Align the element (using the "Aligning a Transmission Element" procedure previously described in this chapter). Use the two tip and tilt knobs on the aperture end of the converter. DO NOT adjust the tip and tilt knobs on the Mainframe accessory receptacle because you will misalign the converter.

TRANSMISSION SPHERE ALIGNMENT ON THE APERTURE CONVERTER

The installation of a transmission sphere on the Aperture Converter may require an additional alignment check. Due to a possible small residual alignment error of about 15 seconds of arc when using the Auto-Align System, it may be necessary to align the spherical reference wavefront to the optical axis of the interferometer using the following procedure.

1. Install and align the Aperture Converter according to the previously described procedure.
2. Place the sample to be tested, or any 4% reflectivity surface (either concave or convex), at the focus of the convergent beam from the transmission sphere. A bull's eye fringe will appear on the viewscreen in the view mode. If this pattern is decentered, it is easily aligned to the center of the viewscreen by using the two adjustment knobs at the receptacle end of the Aperture Converter.

CAUTION:
Do not touch the accessory receptacle tilt adjustment knobs on the Mainframe.

3. The operator may observe that after centering the bull's eye, the concentric rings do not fill the clear aperture displayed on the viewscreen. This vignetting condition is corrected by adjusting the Zygo 3-axis or 5-axis mount along the X and Y axis. The number or position of the fringes may change with focus.
4. Having centered the bull's eye and filled the clear aperture, the sample can now be focused using the following techniques for any spherical or cylindrical testing:
    a. While lightly pushing on the back of the mount, observe the direction that the fringes on the bull's eye move.
    b. If the rings move toward the bull's eye center, turn the Z-axis adjustment knob clockwise to move the sample toward the transmission element until the fringes are straight.
    c. Conversely, if the rings move outward, turn the Z-axis adjustment knob counterclockwise to move the sample out, away from the transmission element.

The orientation and the number of fringes are controlled by adjusting the two accessory receptacle tilt adjustment knobs on the end of the Aperture Converter. For optimum performance, the transmission element should be adjusted so that zero to seven fringes appear on the viewscreen at best focus.

INTERFEROGRAM EVALUATION

In order to evaluate a test fringe pattern, it is necessary to quantify the deviation of the test pattern from some ideal, best fitting pattern. Ideally, the fit of the test pattern to the ideal pattern should be based on a least-squares computation. The deviation, denoted as distortion, is usually presented as a fraction of the space between a pair of fringes in the ideal pattern. Zygo's Interferogram Interpretation and Evaluation Handbook (AB-0001) should be consulted for a more thorough, detailed treatment of this subject. Zygo offers a line of instrumentation to facilitate either real-time interference pattern or interferogram evaluation. Literature is available on request.

CHECKING FOR GEOMETRICAL DISTORTION

Image roundness, as observed on the monitor, may change as the equipment is warming up. This is normal and does not indicate geometrical distortion. In general, roundness will not need to be adjusted. Do not make changes until the equipment is fully warm (at least 30 minutes).

Occasionally a change in image roundness may be observed when changing the interconnection from the Mark II to additional accessories such as the Video Printer or the ZAPP•PC. In most cases, these changes are due to a slight variation in aspect ratio (the ratio of frame width to frame height), and can be ignored. It should be noted that linearity (the variation of vertical or horizontal object size relative to the same object size in the center of the frame) rarely changes.

If the variation in aspect ratio produces undesirable distortion, the procedure outlined below should be followed for making the necessary adjustments. A complete description of the specifications and measurements of geometrical distortion may be found in the EIA Standards RS-170.

Interferometer system quality should be checked periodically in order to be certain that the geometrical distortion is sufficiently low. The distortion may be evaluated as follows:

1. Remove any transmission elements from the accessory receptacle.
2. Place a 2-axis mount approximately 12 inches from the Mainframe, centered in the output beam, and install a reference flat (4% or 90%).
3. Use the Quick FAS System to align the flat.
4. A set of parallel, equally-spaced, straight (taut) wires or strings should be inserted into the beam near the reference flat (oriented vertically). The most convenient object to use is the Zygo Adjustable Parallelogram supplied with every *Interferogram Interpretation and Evaluation Handbook* (AB-0001). The parallelogram may be leaned up against the 2-axis mount.
5. Zoom all the way to 6X and adjust the focus for the most sharply defined lines. Zoom back to 1X.
6. The pattern of lines displayed on the Video Monitor may be inspected visually for distortion and a photograph may be taken with the Video Printer. The photograph may be evaluated in the same manner as an interferogram. If a Zygo ZAPP•PC system is available, the signal from the Mainframe may be evaluated directly.

Note:

ZAPP•PC produces a perfectly round image when the circular mask is selected. The Video Monitor should be adjusted to display the mask as a circle. The Mainframe CCTV should be adjusted such that the aperture image fills the circular mask.

Distortion may be detected in the Video Monitor, the Video Printer, or both. An out-of-round image can be corrected by referring to the Service Manual (SP-0038). In the case of other distortion or nonlinearity, consult the Zygo Service Department.

Chapter 6

MAINTENANCE

The Zygo Interferometer System is virtually maintenance free. However, the system should be treated with care and kept in a clean environment.

PERIODIC MAINTENANCE

1. Clean the blue covers with a soft cloth and a commercially available, mild furniture polish. Clean the gray painted parts with a mild spray cleaner.
2. Lubricate the spring loaded retainer pins located behind the detent clips in the mainframe accessory receptacle. Lubriplate or any similar lithium bearing grease is recommended.

OVERALL CARE OF OPTICS

Since the optics package is enclosed, most of the optics in the mainframe are protected from dust and contamination. Any accessory optics should be placed in protective boxes when not in use to preserve cleanliness, to minimize the need for cleaning, and to provide safety against accidental breakage.

OPTICAL CLEANING PROCEDURE

Optics which are uncoated (4 percent reflectivity), or covered with either an anti-reflective or thin-film coating, are easily damaged by improper or unnecessary cleaning. Clean your Zygo optics only when they are noticeably dirty. It is better to clean a localized area rather than the entire surface. Read the entire procedure before you attempt to clean any optical components.

CAUTION:

Zygo recommends that you do not clean the high reflectivity coatings on transmission or reference elements. These are soft coatings and can be easily damaged. However, if it becomes absolutely necessary to clean one of these surfaces, you can do so following the procedure below. Zygo will not be responsible for any damage that occurs to an optical component as the result of cleaning.

Recommended Cleaning Materials

You will need the following materials and fluids to clean both coated and uncoated optical surfaces. You may use the products suggested below, or their equivalents. Addresses for the manufacturers of the listed products appear in Appendix B.

- Orvus WA Paste, manufactured by KWW Warehouse Chemicals.
- Distilled Water. (Use the best quality available.)
- Spectra-analyzed Methanol, A-408, Class 1B Certified, A.C.S., manufactured by Fisher Scientific.
- Spectra-analyzed Acetone, A-19, Certified, A.C.S., manufactured by Fisher Scientific.
- Multilith Pads, #200-847, manufactured by Multigraphics.
- Lens Tissue, 8 x 9 inch, manufactured by Aldine Papers.
- Vinyl Gloves, #607, manufactured by Laminare.

Preparing to Clean Coated and Uncoated Optics

1. Before cleaning any specialized optical coatings, check the precautionary information supplied with the coatings.
2. Remove all rings and jewelry from your hands and wrists.
3. Wash your hands thoroughly to remove excess skin oils.
4. Put on vinyl gloves.
5. Use a clean, filtered, air supply to blow loose particles from the optical surface without touching the surface itself.
6. Examine the surface for any remaining loose particles and/or semi-solid contaminants. A cleaning procedure for each of the following conditions is described in this chapter: cleaning loose particles from an uncoated surface; cleaning loose particles from a coated surface, and cleaning semi-solid contaminants from a coated or uncoated surface.

Cleaning Loose Particles from an Uncoated Surface

1. Fold two sheets of lens tissue to form a pad approximately two inches square.

WARNING!

Be careful when using Methanol or Acetone; both are TOXIC and FLAMMABLE.

CAUTION:

Do not try to wash off any optical surface with running fluids. If the element is mounted or cemented, this may damage seals or destroy cement bonds. Do not reuse any tissue or pads.

2. Dampen the pad with Methanol. The Methanol should not be dripping from the pad.
3. For **ROUND** surfaces, start at the center and use a light, circular, motion. Wipe gently toward the outer edge using a new pad for each wiping motion.
4. For **SQUARE** or **RECTANGULAR** surfaces, start at one end and wipe gently toward the opposite end, using a new pad for each motion
5. Continue with the above steps until the surface is completely free of loose particles.

Cleaning Loose Particles from a Coated Surface

WARNING!

Be careful when using Methanol or Acetone; both are toxic and flammable.

1. Fold a Multilith pad in fours.
2. Dampen the pad with Acetone. The Acetone should not be dripping from the pad.
3. Follow the instructions for wiping surfaces as listed in the procedure "Cleaning Loose Particles from an Uncoated Surface."
4. Continue with the above steps until the surface is completely clean. DO NOT WASH OFF ANY OPTICAL SURFACE WITH RUNNING FLUIDS. (See the CAUTION above.)

Cleaning Semi-Solid Contaminants from Coated and Uncoated Surfaces

1. Fold a Multilith pad in fours.
2. Dampen the pad with the Orvus solution. The pad should not be dripping.

CAUTION:
Do not scrub the surface. You could cause damage to it.

3. Very gently apply the Orvus to the soiled area, observing the circular and square or rectangular wiping strokes described in the "Cleaning Loose Particles from an Uncoated Surface" procedure. Remember to throw away the used pad.
4. Remove the Orvus from the surface by moistening another Multilith pad with clean, distilled water. Use the established wiping procedure for **ROUND** or **SQUARE** and **RECTANGULAR** surfaces. Throw away used pads.
5. Remove residual water by moistening a pad with Methanol and applying it to the surface following the established wiping procedure. The anhydrous property of the Methanol should draw the water into the pad. Throw away used pads.
6. Remove residual Methanol by moistening a pad with Acetone, and wipe with a single, slow moving light stroke, ending with a "pick-up" motion. (Don't drag the pad to the edge.) Too fast a stroke will leave a gritty trail of Acetone on the surface. Too slow a pickup motion will leave liquid on the surface. Repeat, using a new pad each time, until all traces of Acetone are removed. If light stains are still visible, there is probably some Orvus left on the surface; you will have to repeat Steps 3, 4, and 5 above.
7. If you see remaining contamination after cleaning, repeat the entire procedure.

VIDEO MONITOR MAINTENANCE

This unit is maintenance free with the exception of routine cleaning of the case and screen. There are no user serviceable parts in the monitor. If the monitor needs service, you will have to return it to Zygo.

Clean the sides and top of the unit with a clean, damp cloth, or commercially available, mild spray cleaner.

Clean the screen with a commercially available glass cleaner, or one of the many products on the market for cleaning computer screens.

LASER HEAD REPLACEMENT

Several years of trouble-free use can normally be expected from a laser head. However, the laser head may eventually require replacement because the output power becomes too low or the head ceases to lase. Refer to the Mark II Mainframe Service Manual (SP-0038) for laser head replacement information.

RECOMMENDED SPARE PARTS LIST

It is recommended that the following spare parts be purchased ahead of time so that they will be on hand if needed.

Item	Part Number	Description	QTY	Class*
1.	6174-0101-01	Laser	1	A
2.	6174-0126-01	CCTV Camera	1	A
3.	6174-0209-01	Diffuser Disk Assembly	1	A
4.	6174-0155-01	Motor Drive PCB	1	B
5.	6176-0112-01	Laser Power Supply	1	B
6.	6174-0107-01	Beam Diverger Spatial Filter	1	B
7.	6174-0136-01	Zoom Lens Assembly	1	B
8.	6174-0145-01	FAS Motor	1	B
9.	6174-0146-01	Focus Motor	1	C
10.	6174-0138-01	Remote Control	1	C
11.	6184-0134-01	Video Monitor	1	C

*Parts are classed as to probable frequency of replacement, as follows:

Class A: May need replacement.

Class B: Less likely to need replacement; should be on hand for minimal downtime.

Class C: Least likely to need replacement; stocking optional.

FUSE SCHEDULE

Fuse	U.S.	Europe	Japan
Mainframe	1-1/2 AMP	3/4 AMP	1-1/2 AMP
Accessory	1 AMP	1 AMP	1 AMP
Laser Power Supply	1/4 AMP	1/4 AMP	1/4 AMP

(All fuses are Type 3AG SLO-BLO, 250 V.)

CONTACTING ZYGO OR RETURNING EQUIPMENT

If it becomes necessary to call the Zygo Service Department, it is suggested that you try to do so from a telephone close to the equipment, to facilitate exchange of information about equipment operation.

If you must return equipment to Zygo for service or for other reasons, follow the procedure below.

1. Have the serial number of your unit on hand.
2. Contact the Zygo Service Department for a RETURN AUTHORIZATION (RA) number and the appropriate paperwork. Refer to the title page for contact address and phone number.
3. Pack the equipment securely (in its original container, when possible) to prevent any damage in shipping. Be sure to mark the container with your RA number, and include it on any correspondence.

APPENDIX A

Manufacturers of Optical Cleaning Supplies

The following list contains the names, addresses, and telephone numbers of the manufacturers of optical cleaning chemicals mentioned in Chapter 6.

Fisher Scientific
52 Faclem Road
Springfield, NJ 07081
Telephone: (201) 379-1400

KWW Warehouse Chemicals
Main and Maple Street
Warehouse Point, CT 06088
Telephone: (203) 623-4449

Laminaire Corporation
960 East Hazelwood Avenue
Rahway, NJ 07065-0106
Telephone: (201) 381-8200

Multigraphics
379 University Avenue
Westboro, MA 02090