Zygo Corporation
Laurel Brook Road
Middlefield, CT 06455
USA

Verifire™ Operating Manual

OMP-0604

AMETEK®
ULTRA PRECISION TECHNOLOGIES

Warnings and Notes

Warning!
Denotes a hazard that could cause injury to personnel, and can also cause damage to the equipment.

Note, provides helpful information.

Notices

If equipment has CE Marking it indicates compliance to safety requirements established by the European Union. The directives and standards in compliance are listed in a Declaration of Conformity, which is on file at Zygo Corporation, Middlefield, Connecticut, USA.

Do not dispose of this product as household waste. Use an approved organization that collects and/or recycles waste electrical and electronic equipment. For more information, contact ZYGO Customer Service or your local government office.

FCC Declaration of Conformity

The optional wireless remote contains a radio transceiver that operates at 2.4 GHz, with a transmit power of 10 mW maximum.
(USA) FCC ID: OUR-XBEEPRO
(CANADA) IC ID: 4214A-XBEEPRO
(EUROPE) CE: ETSI
(JAPAN) ID: R 201 WW 08215111

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: 1) This device may not cause harmful interference. 2) This device must accept any interference received, including interference that may cause undesired operation.

This device has passed SAR (Specific Absorption Rate) testing based on FCC rules 2.1091 and FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields, OET Bulletin and Supplement C.

Any changes or modifications to this equipment not expressly approved by Zygo Corporation will void the user's authority to operate the equipment.

OMP-0604 Rev. B December 2017

Table of Contents

Introduction

Chapter 1

Get familiar with safety concerns and your metrology instrument, plus learn about the technology beneath the cover.

Safety Precautions

Failure to follow safety precautions could result in damage to personnel and the instrument, and may void the warranty.

WARNINGS!

- **Disconnect Power During Installation.** Ensure that all power is off during installation, when connecting cables, or when servicing equipment.
- **Ground the Instrument.** To minimize shock hazard, the equipment must be properly connected to an electrical ground through the power outlet.
- **Use Care When Moving Equipment.** It is recommended that several helpers work together when lifting or moving equipment. Contact the appropriate agencies in your country for proper lifting recommendations.
- **Follow Laser Safety Precautions.** The instrument emits Class IIIa laser radiation. It will not damage skin or the eyes, but it is recommended not to look into the instrument aperture. Follow the laser safety recommendations in this manual.
- **Do Not Touch Optical Surfaces.** Do not touch exposed glass surfaces on the instrument or on the transmission elements. Touching optical components will degrade the optical quality of the imaging system.
- **Clean Optics Only When Necessary.** Do not clean optical surfaces unless necessary. Improper and unnecessary cleaning may damage optical coatings.
- **Do Not Modify Equipment.** Do not install substitute parts or perform any unauthorized modification of the equipment.
- **Keep Fingers and Objects Away from Moving Stages.** Motorized stages move during alignment and measurement operations. Keep hands, fingers, and other objects away from the moving stages. For emergencies press the Joystick's Emergency Stop button to stop all stage motion.

Safety Labels

Failure to follow the safety labels on the equipment and the recommendations in this manual could result in damage to personnel and the instrument, and may void the warranty.

Label	Meaning
	General Hazard. Proceed with caution. Refer to the manual for instructions.
	Electrical Shock. Proceed with caution; there is a risk of electrical shock.
	Disconnect power before performing the specified procedure.
	Refer to the manual for complete instructions on performing a specified procedure.

Laser Safety

The interferometer emits visible red light only; no invisible radiation is emitted. The radiant output power of the internal laser and of the instrument is low. The radiation emitted cannot burn or drill holes, even if a lens is used to focus the light. However, the laser light emitted by the interferometer should be treated with caution and common sense. It will not damage skin, but to protect your eyes, do not look directly into the laser beam or stare at its bright reflections.

To encourage proper laser safety and to abide by the above laser safety regulations, ZYGO supplies the information listed on the next page. Refer to the following tables and figures to locate the controls and the labels listed.

Laser Safety Standards

This instrument conforms to the international laser safety regulations listed below.

Organization	Regulation/Standard	Laser Classification
U.S. Department of Health and Human Services (DHHS) Center for Devices and Radiological Health (CDRH)	Title 21 CFR (Code of Federal Regulations) Chapter 1 Subchapter J	Class IIIa
American National Standards Institute (ANSI)	ANSI Z136.1-2000	Low Power - Class IIIa
International Electrotechnical Commission (IEC)	EN 60825-1	Class 3A

Laser classification 3A meets Class 3R requirements per ANSI Z136.1-2014 Appendix J.

Laser safety standards provide reasonable and adequate guidelines for the safe use of lasers. The user and personnel responsible for the safe use of the interferometer should consult the applicable standard.

To encourage proper laser safety and to abide by laser safety regulations, ZYGO provides the following information and drawings.

Product Use Warning

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

Output Beam Data

Laser medium: Helium-Neon

Wavelength: 633 nanometers

Emission Duration: more than 0.25 second

Radiant Power: <5 milliwatt

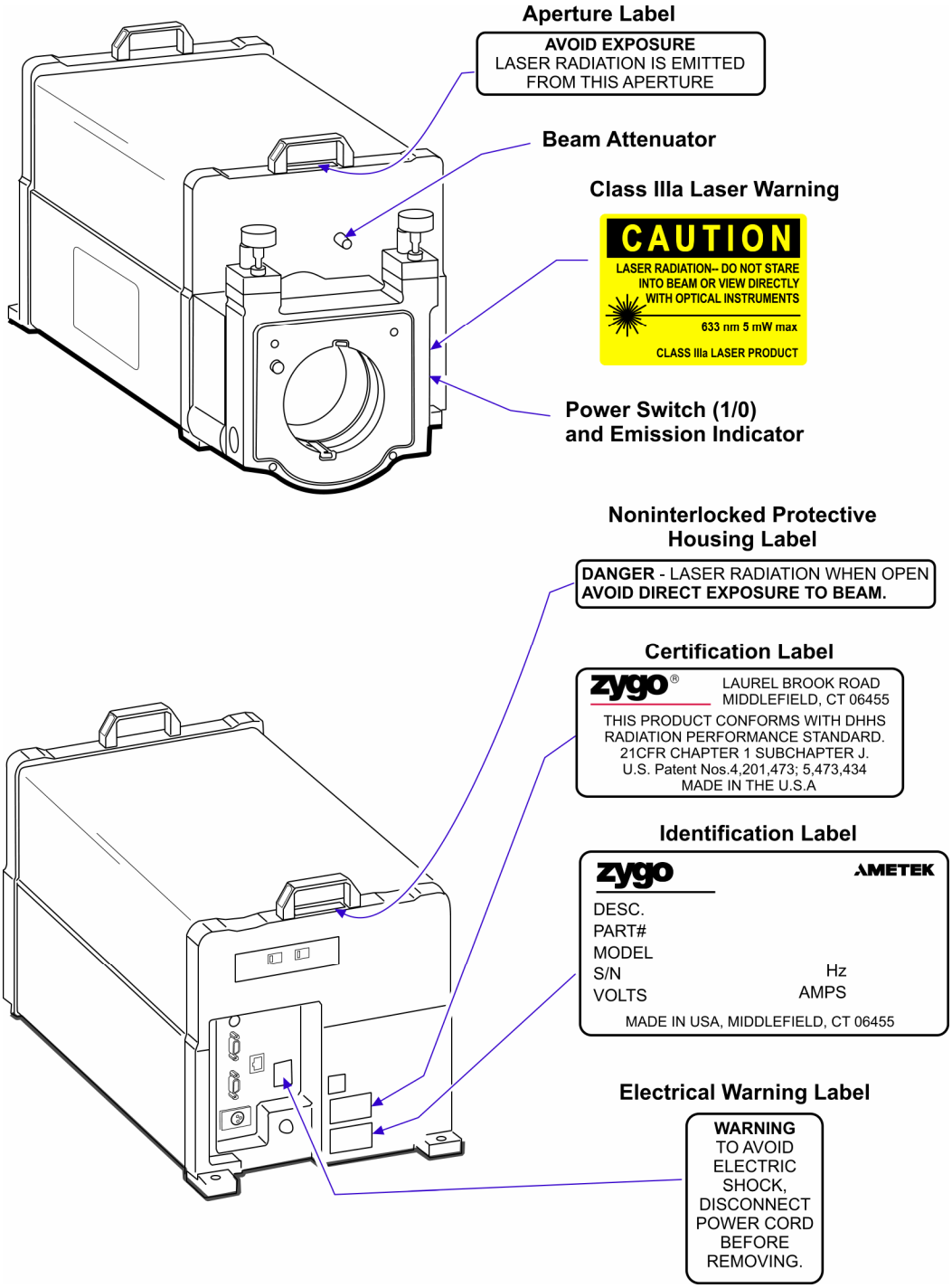
Laser Emission Control Devices

Device	Function
Power Switch (1/0) and Emission Indicator	In the Off position (0), the laser is not energized and laser radiation is not emitted from the instrument. In the On position (1), the indicator light in the switch is lit and laser radiation may be emitted from the instrument's aperture.
Beam Attenuator	When *pulled out*, blocks the laser beam from being emitted from the instrument.

Laser Safety Labels

Label	Purpose
Class IIIa Laser Caution	Requirement for Class IIIa lasers.
Aperture	Labels the instrument's aperture through which laser radiation is emitted.
Interlock	When cover removed, laser radiation is turned off.
Noninterlocked Protective Housing	Reminds you that when the covers are removed, and the system is turned on, laser radiation may be emitted.
Certification	Shows conformance to the U.S. Department of Health and Human Services (DHHS) standard.
Identification	Provides information about the instrument, including serial number, manufacture date, model number, etc.

Laser Safety Controls and Labels



The Verifire[1] Interferometer

The Verifire is an industrial grade Fizeau interferometer used to measure surface form of reflective materials and optics, and transmitted wavefront of transparent optics. It features a high powered stabilized Helium-Neon laser to maximize measurement capability, and Zygo's patented QPSI rapid mechanical phase-shifting interferometry acquisition to provide measurements in the presence of vibration.

The high-power, long-life, frequency stabilized laser provides both the power and stability required for optimum measurement flexibility and performance. Increased optical power is particularly useful when operating at high zoom, or with low camera shutter (QPSI acquisition), or other conditions which reduce the light intensity detected by the camera. Frequency stability improves measurement quality when working with test setups with path lengths of many meters.

QPSI acquisition uses proprietary techniques to measure optics in the presence of vibration. The advanced processing capabilities of QPSI quickly compensates the true rigid body motion of the measurement cavity.

The Verifire is equipped with a high speed camera, motorized 1-6X image magnification (zoom), and motorized focus.

(1) U.S. Patent Numbers 5,473,434, 6,643,024, 6,804,011, 7,710,580, 7,796,273, 7,796,275, and 7,948,639; U.S. and foreign patents pending.

Options

The following factory installed options are available:

Option	Description
Aperture	4 in. (102 mm) or 6 in. (152 mm)
Encoded Zoom/Focus	Both encoded zoom and encoded focus help minimize user variability and increase production throughput by providing simple computer enabled control with repeatable positioning. Preset positions for system zoom and focus can be saved and loaded in software, minimizing set-up time and variability when measuring similar parts. The encoded zoom feature provides a calibrated 1-5X zoom range with bidirectional positioning accuracy of less than 2%. The encoded focus capability is stepper motor driven with high accuracy repeatability.

Mounting Configurations

The Verifire can be mounted in either a horizontal or vertical orientation.

Configuration	Description
Horizontal Configuration	Tabletop orientation. A passive vibration isolation system is recommended with PSI acquisition. A mounting kit is available for use with optical/laboratory tables.
Vertical Configuration	The interferometer can be downward looking or upward looking with an optional vertical kit. A vertical kit consists of three support rods, two L-brackets, baseplate, and a safety baseplate.  ZYGO also offers vertical configurations with specially designed enclosures and built-in vibration isolation systems. Contact your ZYGO representative and ask for information on the MetroCell and Verifire Asphere systems.

Accessories

For information on available accessories see the *Laser Interferometer Accessory Guide, OMP-0463*.

For detailed information on horizontal radius of curvature components, rails, and the 5-Axis Rail Mount, see the *Horizontal Radius of Curvature Manual, OMP-0557*.

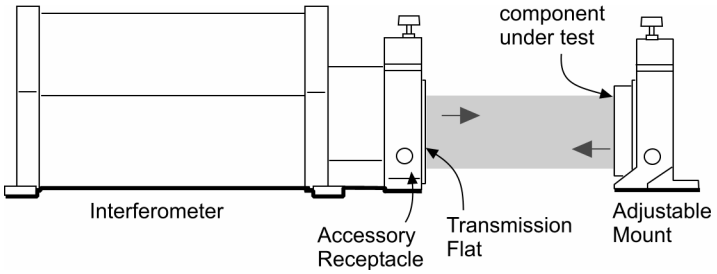
Principle of Operation

The Verifire instruments are Fizeau type-interferometers. In comparison with other types of interferometers, such as Twyman-Green and Mach-Zehnder, a Fizeau interferometer has the advantage of fewer optical components, greater accuracy, and ease of use.

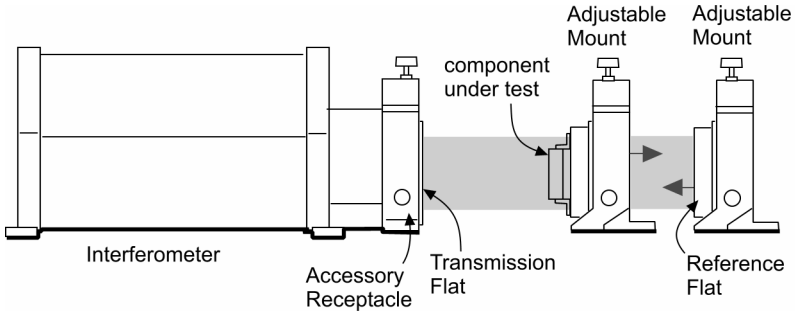
The light source is a helium-neon laser. The laser beam is expanded to a four inch (or six inch) diameter and exits the interferometer through the aperture. A transmission element, mounted in front of the aperture, reflects some of the laser light back into the interferometer, thus creating a reference wavefront. The remainder of the laser light passes through the transmission element to the component being tested and is referred to as the measurement wavefront in the form of an interference pattern.

When performing surface quality tests, the measurement wavefront reflects back to the interferometer from the surface of the component being tested. When performing transmitted wavefront tests, the measurement wavefront passes through the optic under test, reflects back from a reference optic traveling through the optic under test a second time and into the interferometer.

Typical Surface Quality Test



Typical Transmitted Wavefront Quality Test



For both the surface quality test and the transmitted wavefront test, the returning wavefront is recombined with the reference wavefront inside the interferometer, and the two wavefronts interfere with each other. The phase differences between the two wavefronts result in an image of light and dark fringes that is a direct indication of the form of the component being tested with respect to the reference optic. The interference pattern is converted to electrical signals by a video camera enabling software acquisition and analysis.

When performing transmitted wavefront or surface quality tests, the measurement wavefront is affected by the optical component twice, thus the name “double-pass interferometry.” In the interference pattern, defects in the component being tested appear to be twice as severe as they really are. ZYGO software compensates for this with a manual change of the scale factor and, as a result, measurements have twice the resolution of measurements that would have resulted from a comparable single-pass interferometer.

Basic Principles of Phase Measuring Interferometry

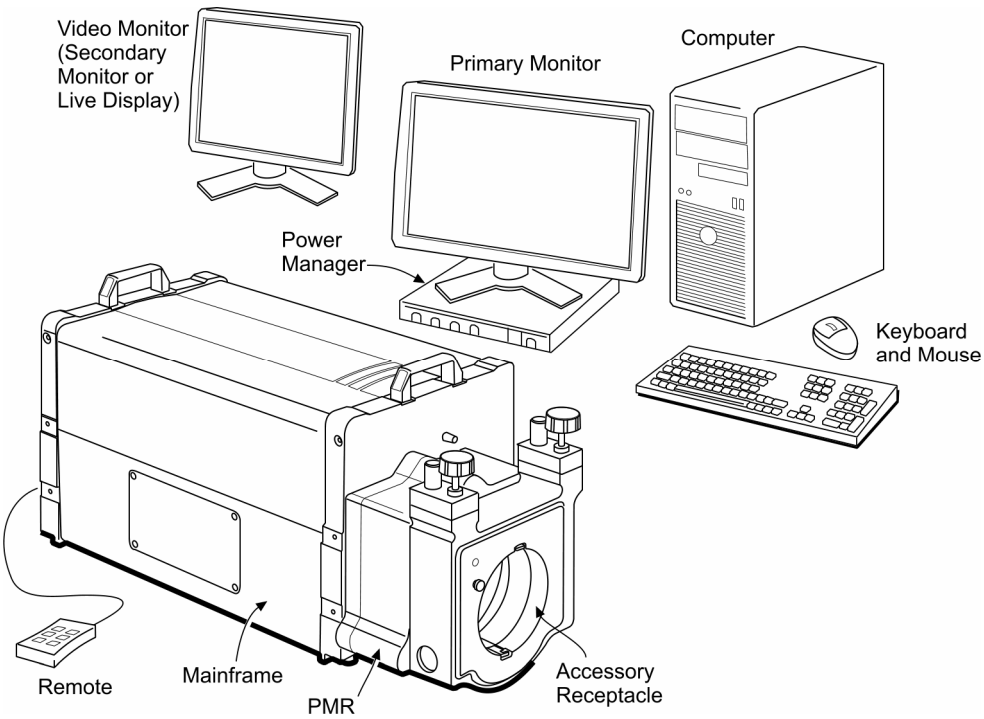
The Phase Measuring Receptacle (PMR) on the Verifire models use piezoelectric transducers to move the transmission element forward and backward, causing constant phase variations between the reference wavefront and the measurement wavefront.

The motion of the transmission element is precisely controlled and is synchronized with the frame rate of the solid-state video camera. During a data acquisition sequence, the computer takes several “snapshots” of the interference pattern (via the camera), each at a point when the interfering wavefronts have undergone a predetermined phase shift in relation to one another.

At the end of the acquisition sequence (typically 13 separate acquisitions) the snapshots are processed by the computer to determine the phase of the wavefront at each point when the interfering wavefronts have undergone a predetermined phase shift in relation to one another. The result is a very accurate map of the wavefront and, therefore, of the quality of the component being tested.

System Components

Typical Components



Component	Description
Mainframe	Mainframe is a term used for the main interferometer body. ZYGO mainframes are high-quality Fizeau interferometers with a laser light source.
Accessory Receptacle	Mounted in the output aperture of the mainframe, it holds and provides for tip/tilt adjustment of mounted optical elements.
PMR	The Phase Measuring Receptacle precisely moves the transmission element as measurements are made to provide phase shifting data.
Remote	Controls settings of the interferometer, such as zoom, operation mode, and focus.
Computer	For system control, data storage, and running ZYGO software.

Component	Description
Keyboard and Mouse	For data entry and software operation.
Video Monitor (Live Display)	Displays a live image of the part under test. It is also used as visual feedback when adjusting the interferometer.
Primary Monitor	LCD main display shows graphics and data.
Power Manager (or power strip)	Distributes power to the system components, provides surge protection, and serves as the system disconnecting device.
Transmission Element	Not shown, optional accessory. A high quality optical lens that forms the reference wavefront for the interferometer. It is mounted into the mainframe accessory receptacle. It may be a Transmission Flat for measuring flat surfaces or a Transmission Sphere for measuring convex or concave surfaces.
L Brackets, Rods, and Baseplates (vertical configuration)	Not shown, optional vertical configuration components. The support system for holding the interferometer components in a vertical configuration. A safety baseplate is included for standalone vertical systems without vibration isolation; vertical rod systems with a vibration isolation table are secured to the vibration isolation table.
5-Axis Stage (vertical configuration)	Not shown, optional vertical configuration components. Z Stage is the term used for the optional motorized platform. It provides a motorized Z-axis to position the test part relative to the mainframe, plus manual tip/tilt and X-Y adjustments.

Computer Components

For details on the computer, keyboard, and mouse refer to the documentation provided by the original equipment manufacturer.

Installation

Chapter 2

Make sure your working conditions are conducive to good metrology. Then position and connect components, and install options.

About Installation

This chapter describes the site and utility requirements, which should be considered before the system is set up. It also provides installation instructions for equipment manufactured by ZYGO. Installation instructions for other components are covered in documentation provided by the original manufacturers.

Warning!
Installation must be performed by ZYGO trained personnel or the warranty may be void.

Site Requirements

Consideration	Comment
Floor	The floor should be as stable as possible to avoid transmission of vibrations into the system. A ground level, poured concrete slab is recommended. An optional vibration isolation system is recommended for the interferometer to minimize vibration effects from other equipment and human activity.
Acoustic Noise	Acoustic (sound) of sufficient amplitude can cause vibration of the instrument, items under test, and even of the vibration isolation table. This is especially true of low-frequency vibrations, which may not be audible even at relatively high amplitude. Uninsulated walls are prone to retransmitting acoustic vibration from adjoining areas and suspended ceilings can couple roof mounted air conditioning noise.

Consideration	Comment
Air Turbulence	The site should be free of air movement. Air turbulence causes uneven air density within small areas, which can refract portions of the measurement beam and alter the measurement. Fans, heaters, and air conditioners should not blow air onto the instrument.
Temperature	For optimum metrology, the temperature of the working environment should be in the range of 20 to 23°C (68 to 73°F) and remain relatively constant. Rapid temperature changes degrade performance by causing uneven expansion and contraction of the instrument and parts under test. Air conditioning, heating devices, or vents, in the nearby area, can cause temperature differences.
Cleanliness	Keep the work environment clean. Over time, dust, smoke, and oil can accumulate on the optics and degrade performance. Keeping the site clean and periodically cleaning the instrument will minimize this concern.

Utility Requirements

Requirement	Comment
Electrical	100/120/220/240 VAC at 50/60 Hz User to provide an isolated 15 amp circuit with an earth ground.
Compressed Air	For optional vibration isolation table. 75 PSI (5.2 bar) dry and filtered source (bottled nitrogen acceptable). The vibration isolation table accepts a 1/4 in. diameter input hose. For metric hoses the user must supply the appropriate adapter, such as available from SMC Pneumatics.

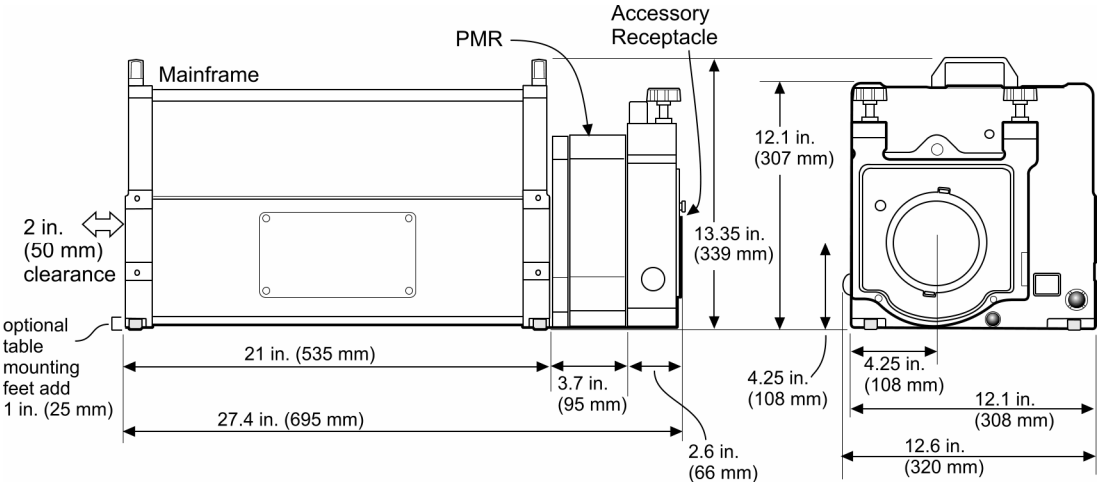
Warning!

The equipment must be electrically grounded through the supply outlet. Any interruption in the ground circuit can cause a shock hazard and could result in personal injury.

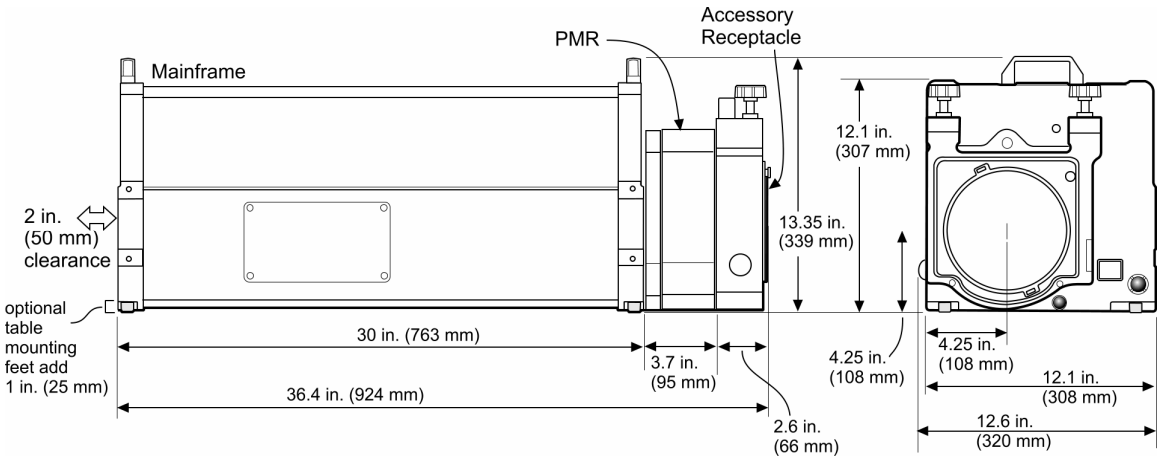
On systems supplied with a power strip or power manger, the plug is used as the “master” disconnecting device. Ensure that the outlet is accessible.

System Layout

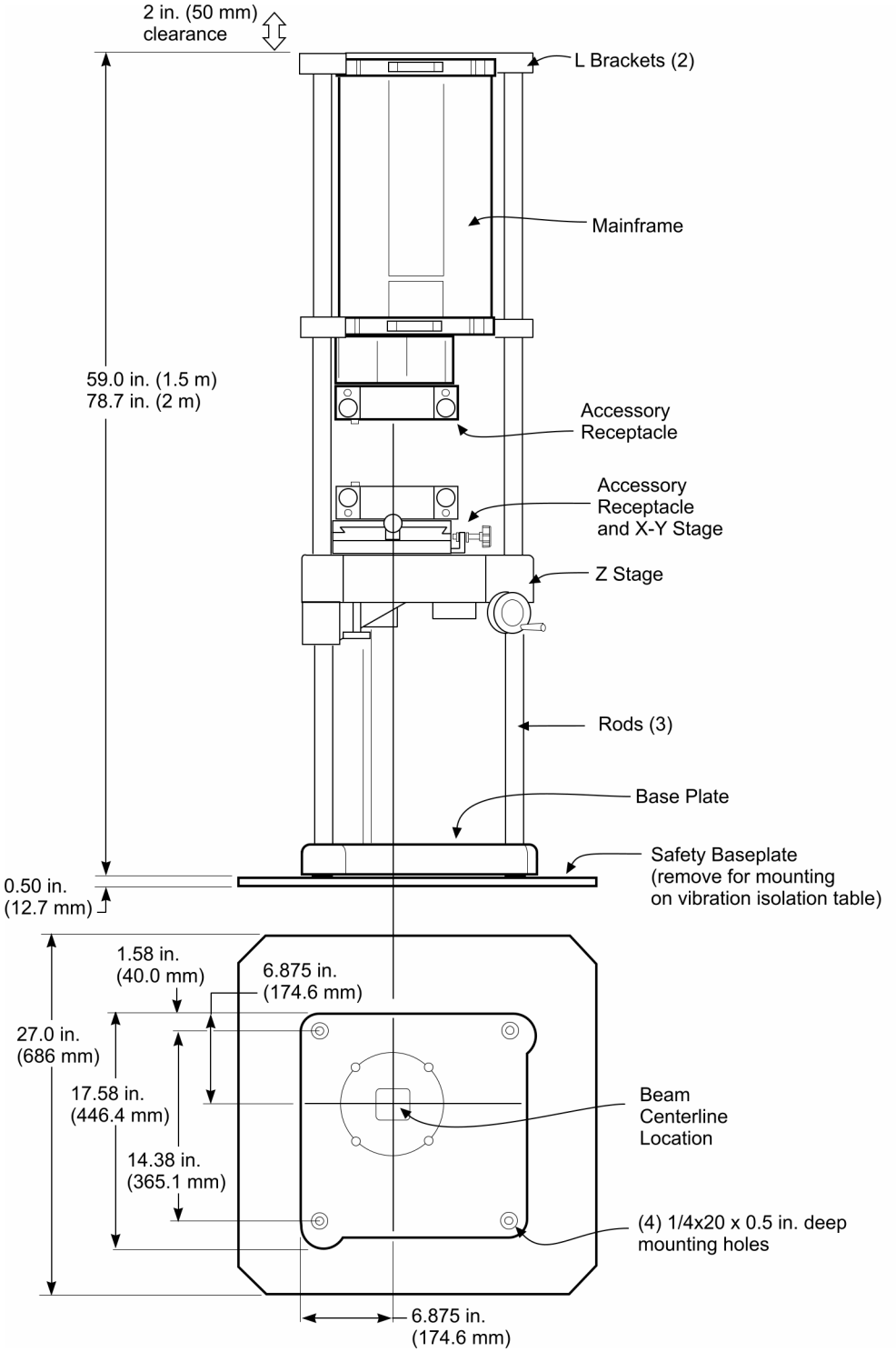
4-inch Horizontal Configuration Footprint



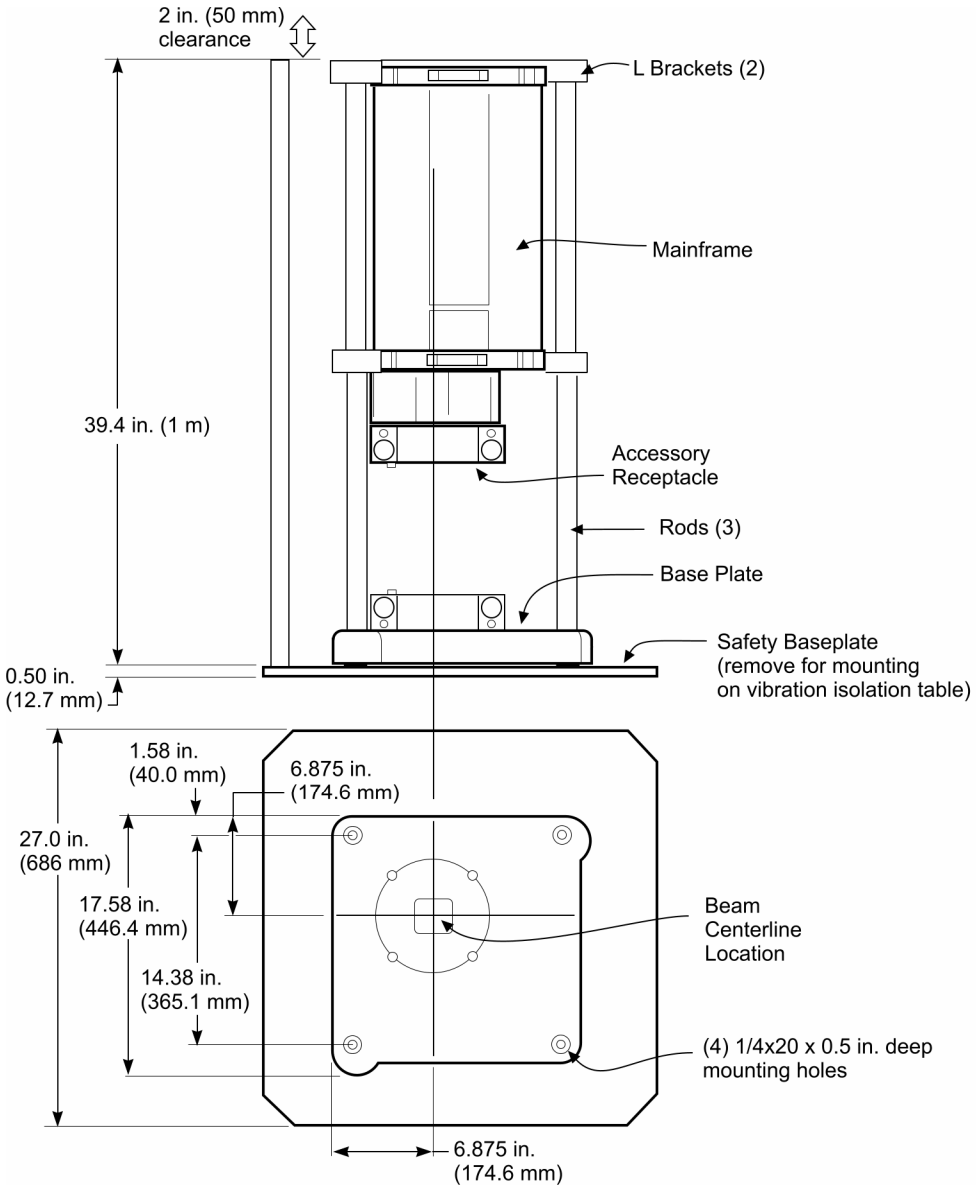
6-inch Horizontal Configuration Footprint



Vertical Configuration Footprint



Vertical Configuration Flat Only Kit Footprint



Preinstallation Checklist

- ☑ 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 required operating environment and utilities.
- ☑ Contact your ZYGO representative to make arrangements for installation and training.
- ☑ Move all shipping containers to the worksite. Allow the equipment to acclimate for at least 24 hours. ZYGO recommends that you save the shipping containers for future transport of the equipment.

Installation Precautions

Warnings!

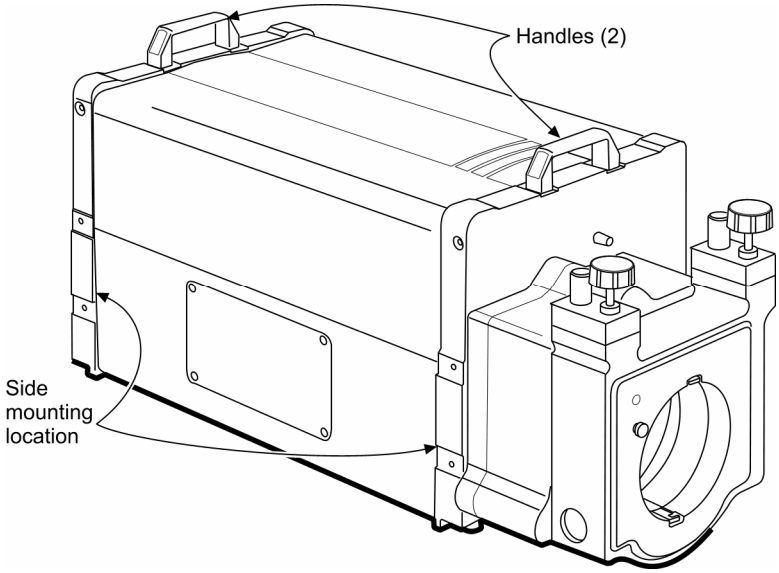
When lifting or moving equipment or pallets, contact the appropriate local and national agencies for proper lifting recommendations.

A typical 4-inch mainframe with PMR weighs approximately 90 lb (41 kg). A typical 6-inch mainframe with PMR weighs approximately 100 lb (45 kg). Have at least two people available to help move the interferometer. Mainframe handles are provided to aid lifting.

The maximum mass that can be mounted on the PMR with the system in the horizontal or downward looking configurations is 60 lb (28 kg). In the upward looking configuration it is 250 lb (113 kg).

Use the handles when lifting or moving the interferometer. Do not lift or push on the PMR or Accessory Receptacle. Handles can be relocated to the left or right side of the mainframe.

Use Handles When Moving the Interferometer



Installing the Horizontal Configuration

As shipped from the factory, the mainframes have feet installed. Simply position the interferometer on the work surface. A vibration isolation table is recommended for optimum performance when using PSI acquisition. Follow the warnings in the “Installation Precautions” section.

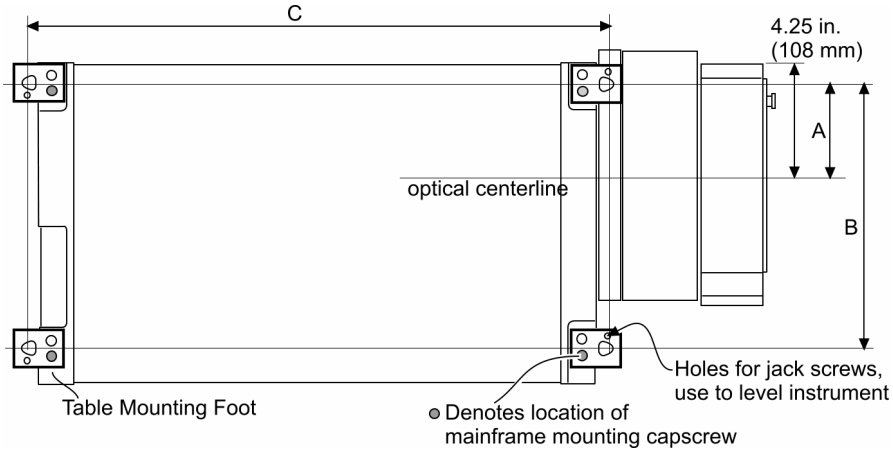
Additional accessories such as a Transmission Flat, 2-Axis Adjustable Mount, a Self Centering Element Holder (SCEH), and other items may be required depending upon the test setup.

Contact your Zygo representative for horizontal table options or if you have questions regarding system installation. Zygo offers a granite top or stainless steel tables (with or without threaded holes) providing vibration isolation. See the *Laser Interferometer Accessory Guide, OMP-0463*.

Optical Table Mounting Kit

With the optical table mounting kit, the mainframe can be mounted to either 1/4-20 holes on a 1-inch grid English table or M6-1.0 holes on 25 mm grid metric table. The kit contains all necessary hardware. The standard interferometer feet must be removed before installing the mounting kit.

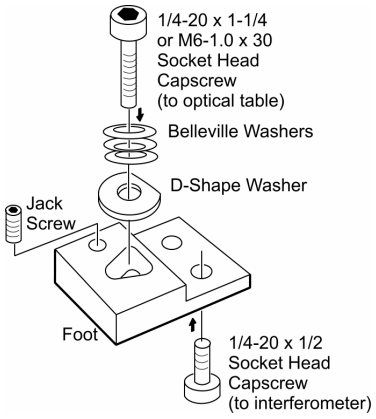
Dimensions for Mounting to an Optical Table
(Bottom View of Interferometer)



Dimension	Description	Inch Table	Metric Table
A	Table hole to beam center	3.50 in.	86.89 mm
B	Table hole spacing	10.00 in.	250.00 mm
C	Table hole spacing	4 inch: 22 in. 6 inch: 31 in.	4 inch: 550 mm 6 inch: 775 mm

For table mounting dimensions when using a ZYGO horizontal rail accessory, see the Horizontal Radius of Curvature Manual, OMP-0557.

Optical Table Mounting Kit Hardware



Installing Vertical Configurations

The interferometer can be installed in either a downward-looking or upward-looking vertical configuration. Follow the warnings in the "Installation Precautions" and "Vertical Handling Recommendations" sections.

Contact your Zygo representative for vertical table options or if you have questions regarding system installation. Zygo offers custom vertical vibration isolation solutions that feature counterweighted tops and a means for securing the vertical baseplate to the table. See the *Laser Interferometer Accessory Guide, OMP-0463*.

Vertical Assembly Summary

Follow the warnings in the "Installation Precautions" and "Vertical Handling Recommendations" sections.

Assemble the interferometer in a horizontal orientation; stand it up vertically only after all components are securely attached.

1. Slide L brackets onto support rods; position the solid rod at the central location.
2. Locate the L brackets so the bracket standoff holes align to the mainframe mounting holes and secure the brackets in place.
3. If using a 5-axis manual part stage, attach the X-Y stage to the Z stage, and attach the accessory receptacle to the X-Y stage.
4. Slide the 5-axis stage onto the rods.
5. Place the three rods into the baseplate and secure. The threaded rod from the Z stage aligns to a hole with bushing in the baseplate.
6. Attach the mainframe to the L brackets using 4 capscrews.
7. Attach the safety baseplate to the bottom of the baseplate.
8. Lift the system to vertical.

Vertical Handling Recommendations

Always handle assembled vertical configurations from both ends and in the middle of the rods directly next to an L-bracket or z-stage. Depending upon the actual location of components, the configuration may be either top or bottom heavy. Never move the vertical system by grabbing the accessory receptacle or mainframe handles.

Warning!
A typical 4-inch vertical system weighs approximately 160 lb (73 kg) with the baseplate and rods. A typical 6-inch vertical system weighs approximately 170 lb (77 kg) with the baseplate and rods. Have several people available to assemble and move this system. Contact the appropriate agencies in your country for proper lifting recommendations.

Upward-looking Adjuster Mounting Block Orientation

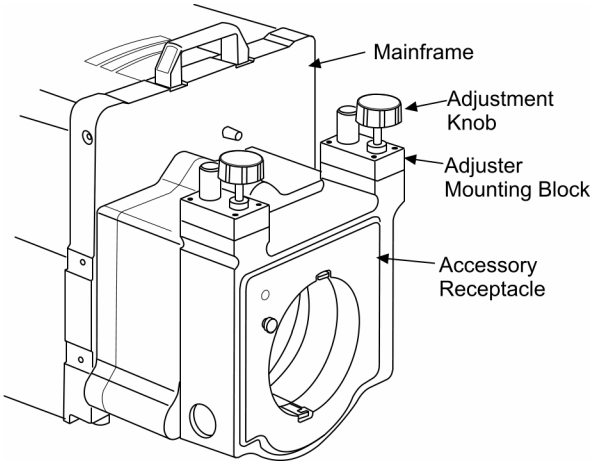
When the interferometer is assembled in an upward-looking configuration, it is necessary to change the orientation of the mainframe accessory receptacle adjuster mounting blocks to reduce the load on internal springs. Proper orientation of the adjustment knobs optimizes stability and minimizes vibration.

Proper Mainframe Accessory Receptacle Knob Orientation

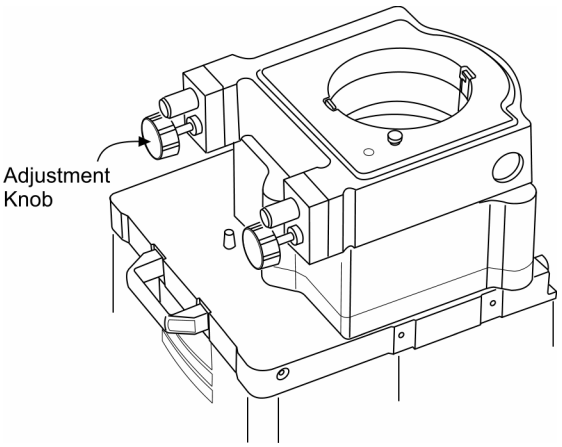
Configuration	Accessory Receptacle Adjustment Knob Position
Horizontal, Downward	Knobs positioned closest to the outside face of the accessory receptacle. (factory orientation)
Upward	Knobs located closest to mainframe.

1. Turn the mainframe off.
2. Remove any installed transmission element (see Chapter 3).
3. Turn the adjustment knob counterclockwise 2-3 turns.
4. Using an 3/32 in. Allen wrench, remove two of the #4-40 x 7/8 socket head capscrews from diagonally opposite corners of the adjuster mounting block.
5. While holding the block in place, carefully remove the last two capscrews.
6. Remove the block and rotate it 180 degrees from its original position.
7. Attach the block to the receptacle using the original capscrews. Do not over tighten the capscrews.
8. Repeat for the other adjuster mounting block.

Factory Orientation of Adjustment Knobs



Upward-Looking Configuration



Connecting Cables

General Cable Guidelines

- Remove protective caps from connectors before attaching cables.
- Before connecting each cable, ensure that both connectors are correctly oriented and aligned.
- Locate cables so they do not introduce vibration into the system.

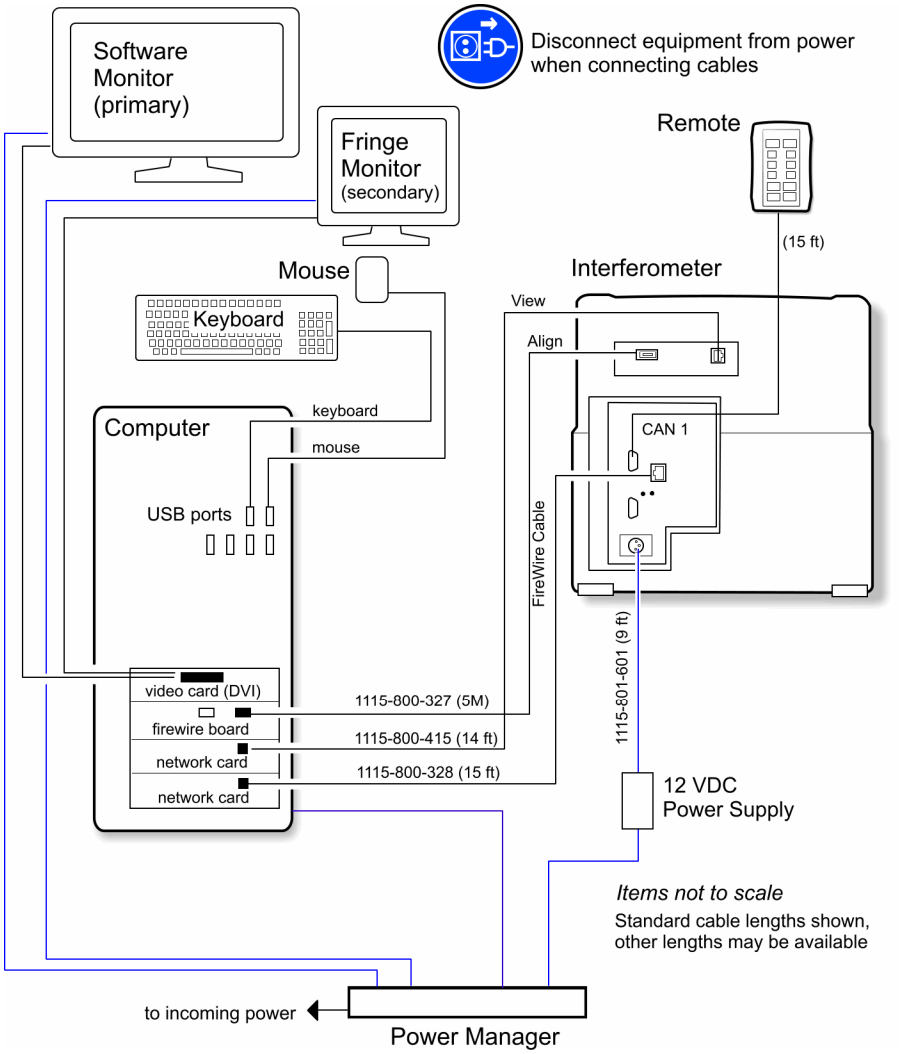
Warnings!

Disconnect equipment from power before connecting cables. Failure to do so may cause damage to the equipment.

The equipment must be electrically grounded through the supply outlet.

The power strip (or power manager) is for system power distribution only. Do not plug cords from other equipment into the power strip.

Cable Connections



Operation

Chapter 3

Learn how to operate your interferometer and gain insight into important operational procedures.

Operating the Interferometer

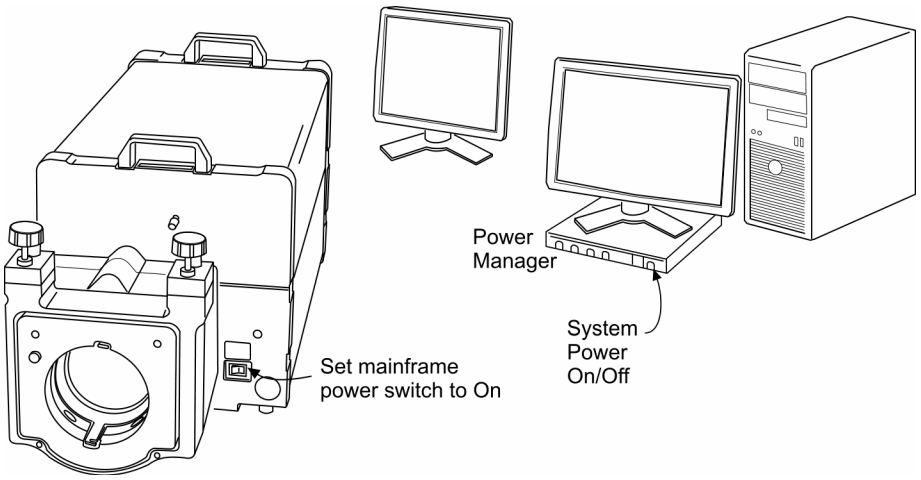
Warning!
The operator must be trained before operating the system. Read all operation instructions before starting the equipment. The equipment should only be used in the manner for which it is intended.

Use of ZYGO Mx software is described in other manuals or in online help.

Start-up

Warning!
If the system is equipped with motorized axes, the operator is responsible to make sure the joystick is not activated when the system is first started. People and objects must be clear from moving stages. To stop stage motion in an emergency, press the Emergency Stop button.

Master Power Switch



1. Push the mainframe Beam Attenuator in. Turn on all components.

Some systems include a power strip (or power manager), which can be used to turn on all components with one switch.

2. After the Windows welcome message appears, press Ctrl-Alt-Delete to log on.
3. In the Windows log on screen, type the system password.
4. Locate the ZYGO program icon and double-click it to open.

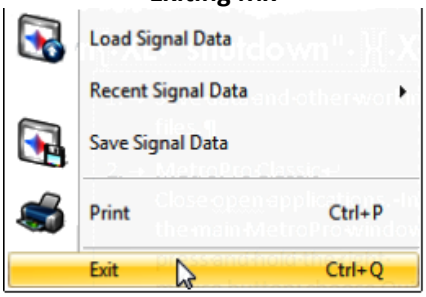
Windows Log On Screen

Allow from 15 to 30 minutes when first turning the interferometer on, for the laser to lock before making measurements. The stabilized laser is stable and ready for use when the Power Switch green light remains on (not blinking).

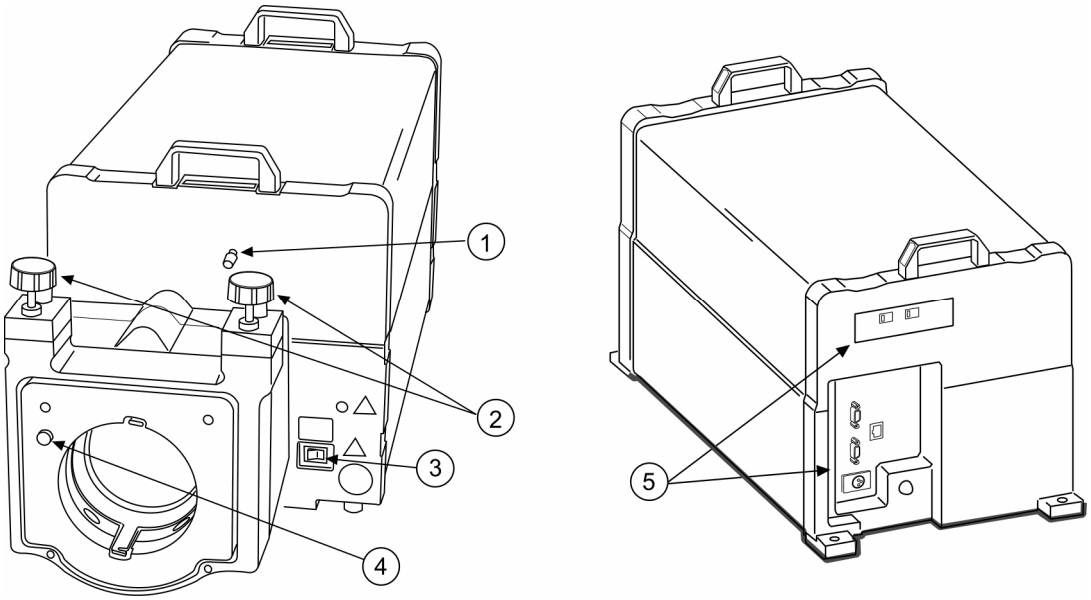
Shutdown

1. Save data and other working files.
2. On the File menu select Exit or press Ctrl+Q.
3. From Windows, use the Start menu and click Shut down.
4. Turn off all components.

Exiting Mx



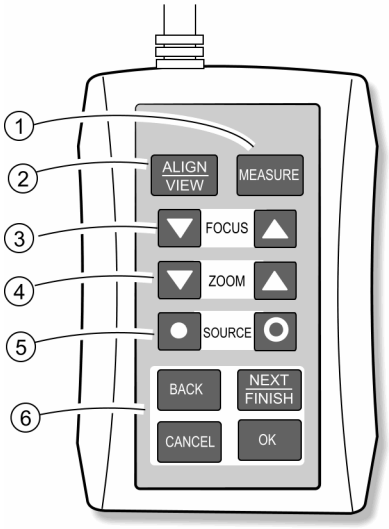
Mainframe Controls



Ref	Item	Description
1	Beam Attenuator Knob	When pulled out, blocks the laser beam from being emitted from the instrument.
2	Accessory Receptacle Tip/Tilt Knobs	Adjusts the tip and tilt of a transmission element mounted in the Accessory Receptacle. Used to align the element to the interferometer.
3	Power Switch (1/0) and Emission Indicator	In the Off position (0), the laser is not energized and laser radiation is not emitted from the instrument. In the On position (1), the indicator light in the switch is lit and laser radiation may be emitted from the instrument's aperture. The emission indicator is also a laser lock indicator. A green blinking light indicates the laser is not stabilized; a solid green light indicates the laser is locked.
4	Accessory Receptacle Locking Knob	Turn clockwise to lock the installed transmission element in place in the Accessory Receptacle.
5	Connector Panels	Provides connections to the computer, remote, and power.

Remote

Both a Wired and a Wireless Remote control are included. Both remotes are used to control the instrument's hardware settings and provide some basic software interaction.

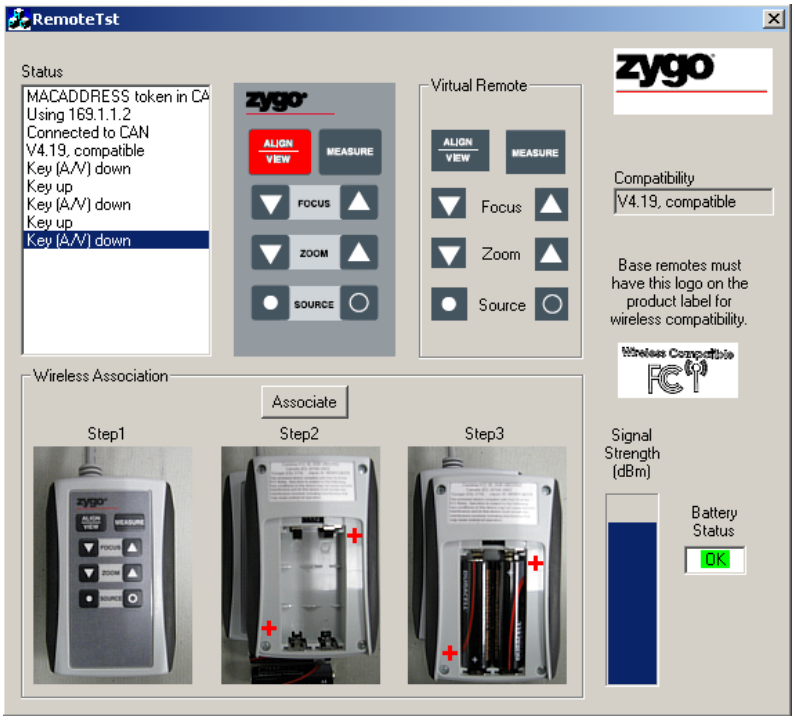


Ref	Button	Description
1	Measure	Begins a measurement.
2	Align/ View	Toggles the operation mode. In View mode the light level is 10%. In Align mode the light level is 100%.
3	Focus	Focuses the interferometer in the indicated direction.
4	Zoom	Adjusts the size of the image area in the indicated direction.
5	Source	Nonfunctional in this model.
6	Back Cancel Next/Finish OK	Alternative buttons for Mx user actions.

Configuring the Wireless Remote

The wireless remote is associated with the wired remote at the factory. It is only necessary to perform this procedure when the wireless remote batteries are changed, if the wireless remote is used on a different instrument, or if the wired remote is changed.

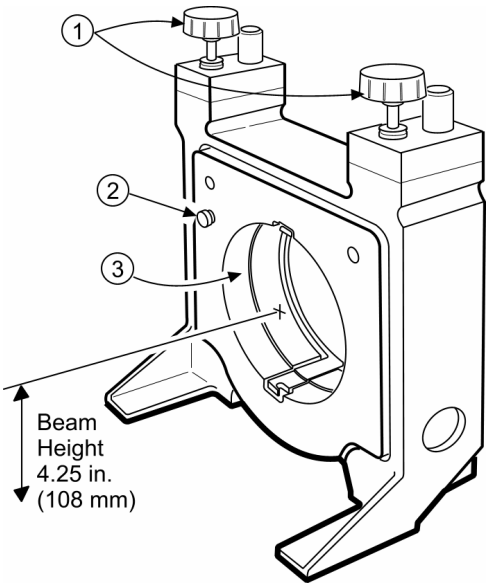
1. Turn on the interferometer.
2. Open the RemoteTst utility program. It is located in the Zygo Corporation>Utilities folder in the Start Menu.
3. Press the Align/View button on the wired remote. The Align/View button on the RemoteTst screen is highlighted red (see next page).
4. Remove the battery cover from the wireless remote and remove the batteries.
5. Place the wireless remote directly on top of the wired remote.



6. Click the Associate button on the RemoteTst screen.
7. Replace the batteries immediately (within 20 seconds) in the wireless remote following the polarity identified on the screen.
8. Replace the battery cover.

2-Axis Adjustable Mount (Accessory)

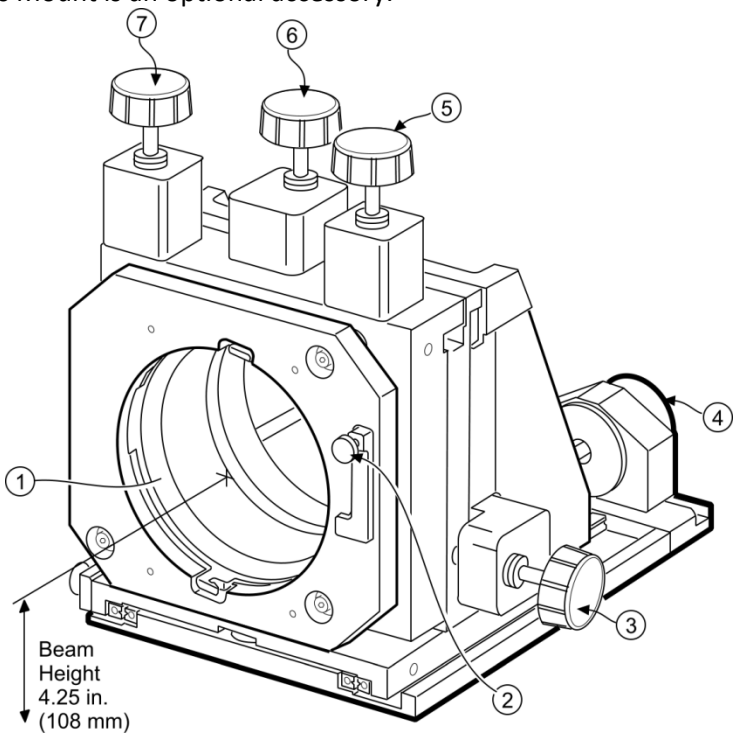
The 2-Axis Adjustable Mount is an optional accessory.



Ref	Control	Description
1	Tip/Tilt Knobs	Adjusts the tip and tilt of a test part. Used to align the test part to the interferometer. Provide ±2º adjustment.
2	Locking Knob	Turn clockwise to lock the installed accessory, such as a Self Centering Element Holder, in place in the Adjustable Mount.
3	Receptacle	Depending on the model, a 4 in. or 6 in. diameter bayonet mount for corresponding accessories. The nominal optical centerline height is 4.25 in. (108 mm).

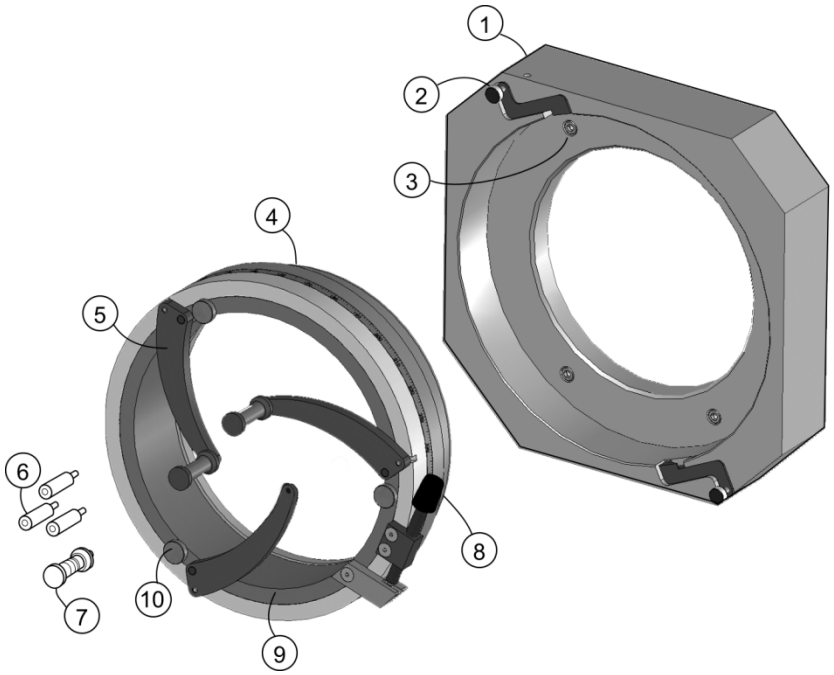
5-Axis Mount (Accessory)

The 5-Axis Mount is an optional accessory.



Ref	Control	Description
1	Receptacle	4 in. diameter bayonet mount for corresponding accessories. The nominal optical centerline height is 4.25 in. (108 mm).
2	Locking Knob	Turn clockwise to lock the installed accessory in place in the Mount.
3	X Knob	Adjusts the part location in the x-axis. Provides range of ±0.5 in. (±13 mm).
4	Z Knob	Adjusts the part location in the z-axis. Provides 2 in. (50 mm) of travel.
5	Tilt Knob (pitch)	Adjusts the tilt (or pitch) of a test part. Used to align the test part to the interferometer. Provides ±2º adjustment.
6	Y Knob	Adjusts the part location in the y-axis. Provides range of ±0.5 in. (±13 mm).
7	Tip Knob (roll)	Adjusts the tip (or roll) of a test part. Used to align the test part to the interferometer. Provides ±2º adjustment.

6 inch Self Centering Element Holder and 6 inch Adapter



Ref	Item (Quantity)	Description
1	6 inch Adapter	Adapts 4-inch mount receptacle to accept 6-inch accessories.
2	Locking Knob (2)	Turn clockwise to lock the installed accessory in place.
3	Captive Cap Screw (4)	Secures the adapter to the face of the 5-axis mount.
4	6 in. Self Centering Element Holder	Holds test part and centers it within the measurement beam; accommodates parts of various diameter and thickness.
5	Arm (3)	Pivot in or out to accommodate different part diameters, and provides 8-32 threaded hole for post.
6	Straight Post (3)	Straight posts screw into arms to hold part edge.
7	Stackable Post (3)	Stackable posts screw into arms to hold part edge. Features an adjustable V-block and 5 spacer rings per post.
8	Arm Knob	Tighten to secure the test part between the three posts.
9	Inner Ring	Allows the three arms to be rotated to any location.
10	Thumbscrew (3)	Tighten to secure the inner ring in position.

6 inch Adapter (Accessory)

The 6 inch bayonet mount adapter allows the 5-axis mount to accept 6 inch accessories and maintains the 4.25 in. beam height. Three dowel pins on the back of the adapter serve as stops to align it to the mount. The pocket on the back of the adapter fits over the clamp arm on the front of the 5-axis mount.

To attach the 6 inch Adapter to the 4 inch bayonet mount:

1. Place two of the adapter dowel pins on the top surface of 4 inch mount, then slide the adapter until the third dowel pin sits against the outside of the left side of the mount (as viewed from the front face of the bayonet mount).
2. Secure the adapter to the mount using a 9/64 in. Allen wrench to tighten the 4 captive cap screws.

6 inch Self Centering Element Holder (SCEH) (Accessory)

This adjustable part holder accommodates circular parts from 5 to 200 millimeters. The holder features 3 stackable V-block posts for parts of different thickness (or 3 straight posts) and an inner ring, which can be rotated and locked in position.

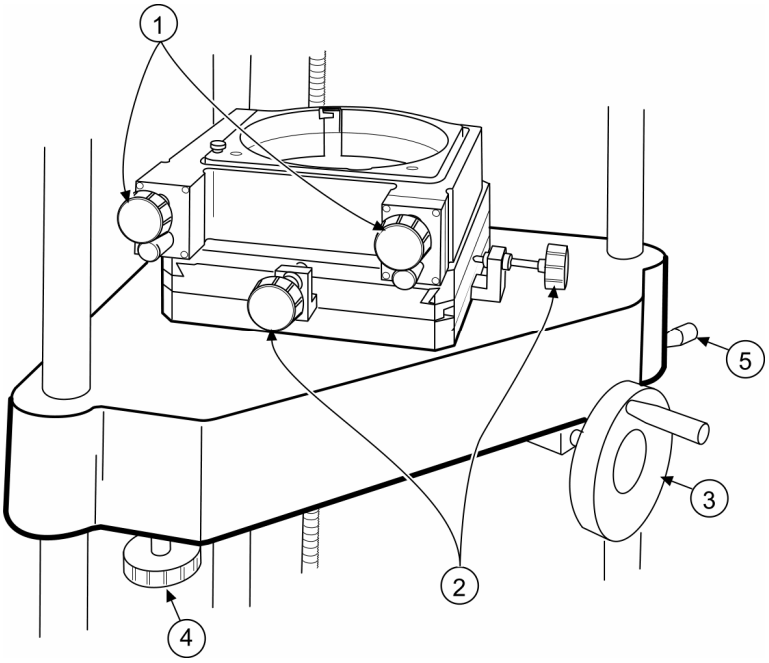
Using the SCEH

- Align the side pins of SCEH to the 6-inch bayonet mount and turn until it clicks in place. Tighten the locking knobs to secure.
- The stackable posts serve as adjustable V-blocks. The V is formed by two end caps on each post. The size of the V is determined by the stack-up of the spacer rings. Adjust the spacer stack on each post to accommodate the edge of the test part. The straight posts can be used as an alternative.
- Screw one stackable post or one straight post into each arm.
- Place the test part between the V-blocks or against the straight posts and secure the part in place by tightening the arm knob. Tighten only enough to hold the part.

  Warning!
  Use the holder with care. If the arm knob is over tightened, the test part can become distorted and/or damaged. ZYGO is not responsible for mishandled parts.
- For best part support, rotate the inner ring so two posts are at the bottom. Secure the inner ring in position by finger tightening the three thumbscrews.

5-Axis Vertical Stage (Accessory)

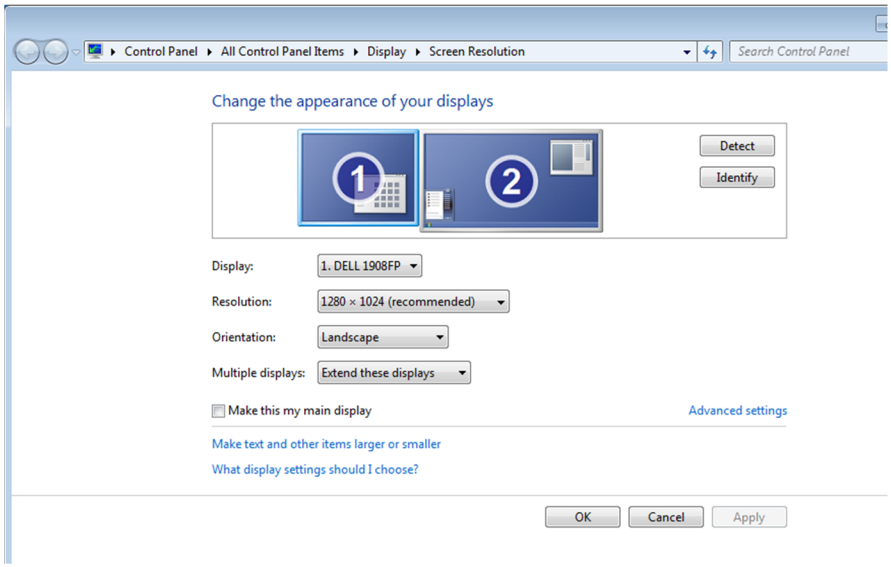
The 5-Axis Vertical Stage is included with most vertical workstation kits.



Ref	Control	Description
1	Accessory Receptacle Tip/Tilt Knobs	Adjusts the tip and tilt of a test part. Used to align the test part to the interferometer. Provide ±2º adjustment.
2	X and Y Knobs	Adjusts the lateral location of the Accessory Receptacle in X and Y axes. Used when measuring spherical parts. Provide range of 0.5 in. (13 mm).
3	Stage Movement Crank	When turned it moves the 5-Axis Stage in the Z axis along the rods in coarse increments.
4	Fine Z Control	Moves the 5-Axis Stage in the Z axis along the rods in fine increments.
5	Z-axis Locking Wheel	When tightened, the 5-Axis Stage is secured to the rods.

Checking the Monitor Setup

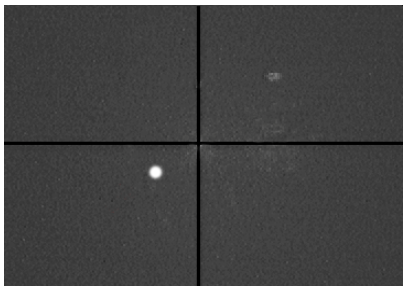
It may be necessary to check the monitor arrangement if the operating system is not configured for two monitors. The main display serves as the main software screen and the second monitor serves as the Live Display. The live display may also be referred to as the fringe monitor or video monitor.



1. Right-click the desktop, and then click Screen resolution.
2. Two monitors should be visible as shown here.
3. The Multiple displays drop-down should be set to “Extend these displays”.
4. To change which monitor is the main display, select the second monitor icon and click the “Make this my main display” checkbox.
5. The display order can be changed by clicking and dragging the monitor icons to new positions.
6. Click OK or Apply.
7. It may be necessary to open the Live Display screen in the software and drag it onto the second display.

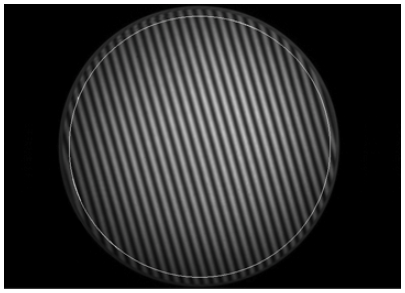
The Live Display

The Live Display shows a live image of the part under test. It typically is displayed in the second monitor. Some uses of the display are shown below.



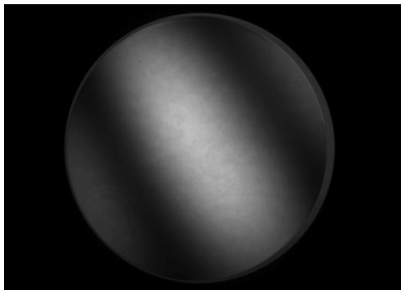
Test Part Tilt Feedback

The Live Display provides feedback on the tilt of the test part when the system is in align mode. Adjust the tip and tilt knobs on the Adjustable mount to move the brightest dot into the center of the crosshairs.



Display Fringe Pattern and Zoom Aid

The Live Display shows a fringe pattern image of the test part and a mask. The fringe pattern is the light and dark bands caused by interference of light reflected from the part surface. The mask is created with the Mask Editor and defines the outer border of the analyzed data. Push the Remote's Zoom buttons (1X and 6X) to fill the mask with the fringe pattern.



Nulled Part Aid

The Live Display shows a nulled fringe pattern. The term "null" means to minimize the number of fringes. This means the tilt of the test part is adjusted so the light striking the part reflects back into the instrument.

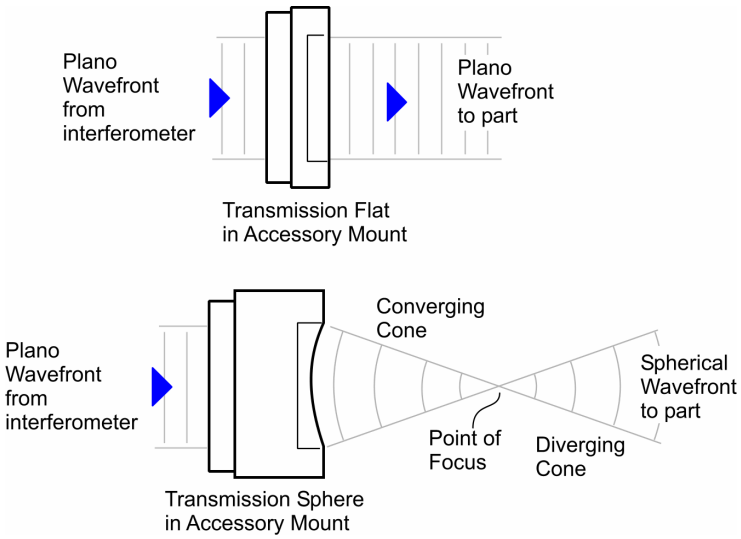
Selecting Transmission Elements

The term “Transmission Element” refers to a Transmission Flat or Transmission Sphere. The quality of the transmission element selected for testing is important to the accuracy of the measurement. The element’s front surface (reference) forms the reference wavefront to which the surface (or transmitted wavefront) is compared. Therefore, the accuracy of the measurement is directly related to the quality of the transmission element used. ZYGO offers a wide variety of transmission elements including flats and spheres for testing optical components.

The Measurement Wavefront

Laser light passing through the transmission element becomes the measurement wavefront. A Transmission *Flat* allows the collimated laser light to pass through unaltered, resulting in a plano measurement wavefront traveling in a straight shaft of light. A Transmission *Sphere* converts the collimated laser beam to a spherical wavefront, which is a converging cone of light as it leaves the Transmission Sphere and becomes a diverging cone of light after passing the point of focus.

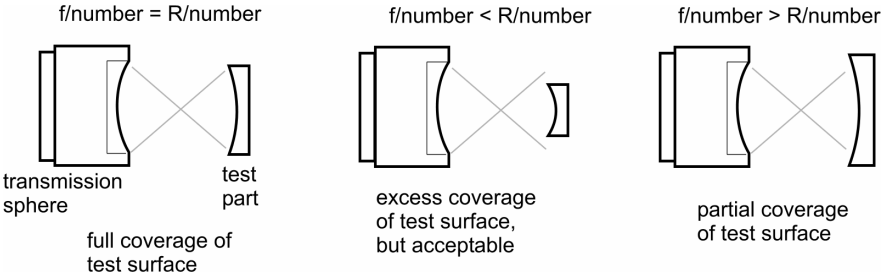
Measurement Wavefronts



Selecting Transmission Spheres for Concave Surfaces

To measure the entire surface of a test part, the cone of light from the Transmission Sphere must be large enough to completely cover the surface being tested. To achieve this, the f/number of the Transmission Sphere must be equal to, or less than, the R/number of the test part.

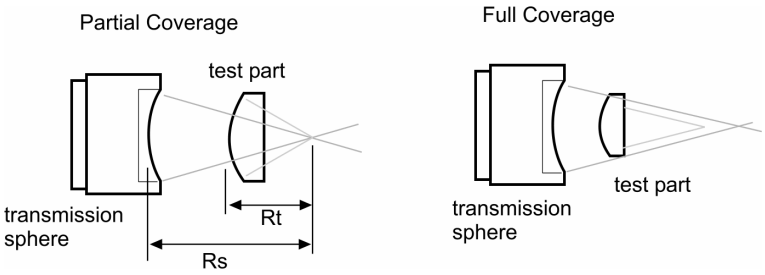
Selecting Transmission Spheres for Measuring Concave Surfaces



Selecting Transmission Spheres for Convex Surfaces

To measure at least a portion of a convex surface, the radius of curvature of the surface must be shorter than the distance from the front surface of the Transmission Sphere to its focal point. To measure the entire surface of a convex element, the f/number of the Transmission Sphere must also be less than the R/number of the convex element.

Selecting Transmission Spheres for Measuring Convex Surfaces



Radius of convex test surface (Rt) must be less than the distance between the Reference Sphere surface and the focal point (Rs).

In this diagram, the f/number is higher than the R/number, resulting in only partial coverage of the test surface.

To test the entire surface, the f/number must be less than the R/number.

Installing Transmission Elements

Warning!
In the steps that follow, do not touch the surface of the transmission element. Fingerprints can permanently damage the optical coating and surface.

1. Grasp the element by the metal edges and remove it from the protective container.
2. Align the two small metal pins on the edges of the element with the two slots on the Interferometer Accessory Receptacle.

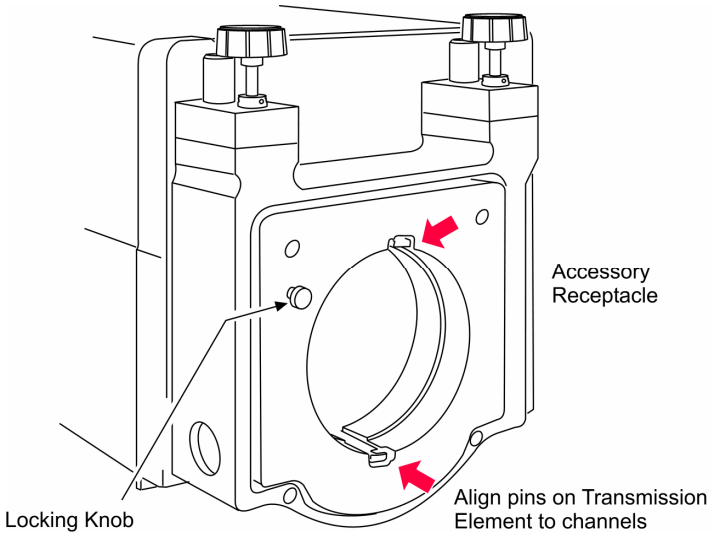
Mount accessories so the S/N label and ZYGO logo are located on top (closest to the accessory receptacle knobs).

Warning!
When the system is assembled in the downward looking configuration, *do not remove* your hand from the transmission element until you have locked it in place in the Accessory Receptacle as described in the next step.

3. Gently push the element into the interferometer Accessory Receptacle and continue to hold the element in place touching only the metal edges. Turn the black locking screw clockwise. This locks the element into the accessory receptacle.

To remove the element from the Accessory Receptacle, support the element by holding it on the metal rim and then turn the black locking screw counter clockwise.

Installing a Transmission Element

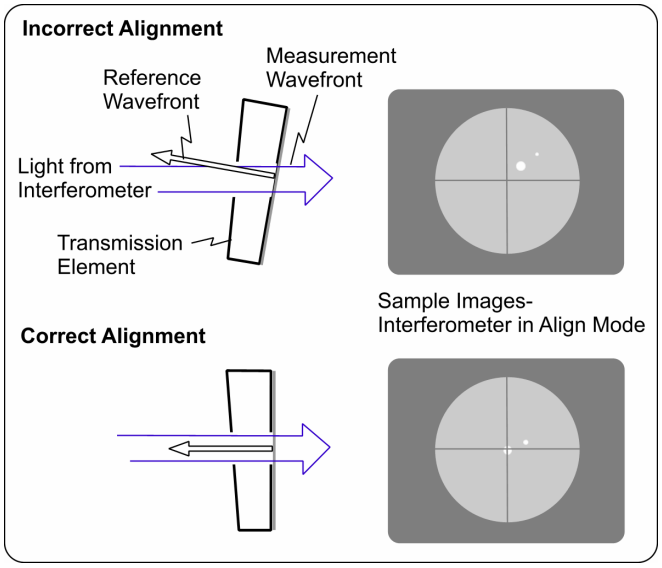


Aligning the Transmission Element

Before you can make measurements, you must align the transmission element to the interferometer and then align the test part to the element. Aligning either transmission flats or transmission spheres is covered below.

Aligning the test part is covered in the "Measuring Surface Quality" and "Measuring Transmitted Wavefront Quality" sections.

Aligning a Transmission Element



1. Ensure that the Beam Attenuator knob is in the ON position (pushed in).
2. Press the ALIGN/VIEW button on the Remote. The alignment target (crosshairs) and one or more bright spots will appear on the monitor. The brightest spot represents the reflection off the outermost surface of the transmission element.
3. Turn the tip and tilt knobs on the *interferometer's* Accessory Receptacle until the brightest spot is superimposed on the crosshairs center.

Aligning DynaFlect Transmission Flats

For Dynaflect coated transmission flats, a more precise alignment of the transmission flat is required than can be achieved using the alignment reticle only. A retroreflector (corner cube) is required for precise alignment. Suggested specifications for the retroreflector are: 63.5 mm aperture in 5 arc seconds beam deviation grade.

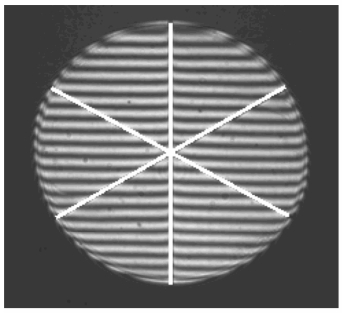
The high reflectivity coating on the Dynaflect flat returns approximately 10% more light to the interferometer's alignment target than other flats. If there is even a small degree of tilt present, a secondary fringe pattern may be present that will create an artifact in the measurement.

Perform the procedure at "Fine Alignment of a Transmission Flat" to ensure that the reference surface of the transmission flat is precisely perpendicular to the optical axis of the interferometer, thus eliminating this artifact.

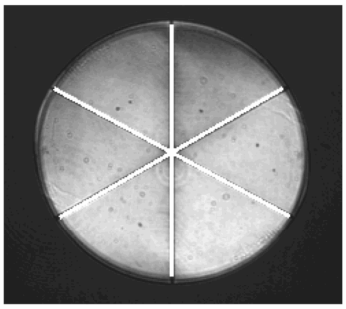
Example Images Using a Retroreflector for Alignment

Retroreflector #1 Beam Deviation: 1 arc seconds

Misaligned

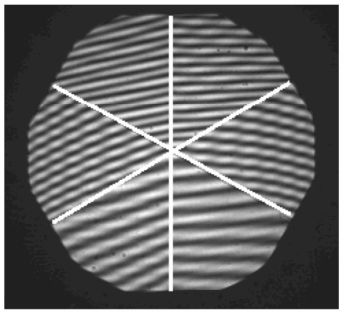


Aligned

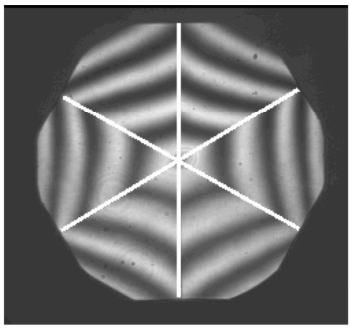


Retroreflector #2 Beam Deviation: 14 arc seconds

Misaligned



Aligned



Note that it was not possible to null pattern; the important factor is that the pattern is symmetrical.

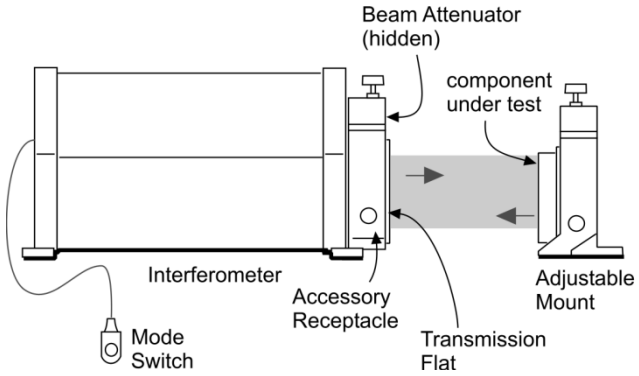
Measuring Surface Quality

Testing a Plano Surface

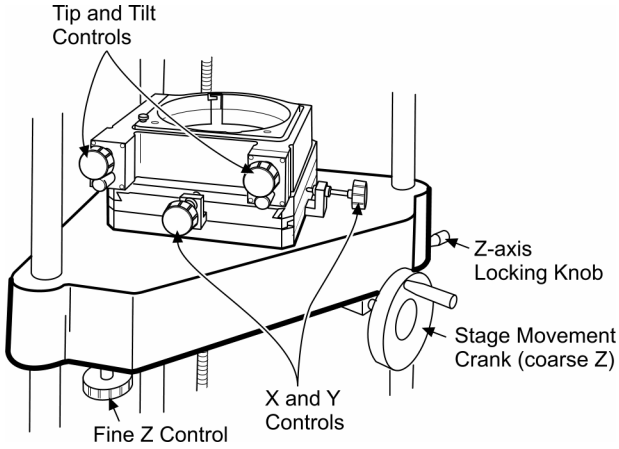
Required Equipment:

- Transmission Flat
- 5-axis Stage (for vertical configuration)
- Adjustable Mount, 2-axis (stage) (for horizontal configuration)

Plano Surface Measurement (Horizontal)



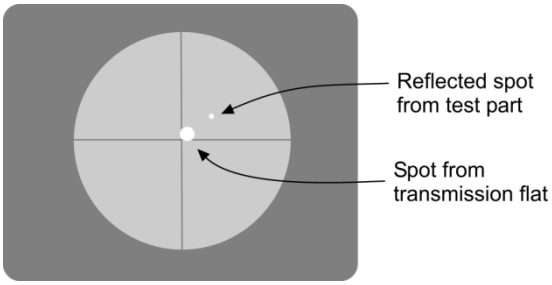
5-Axis Stage (Vertical)



1. Press the Remote ALIGN/VIEW button to put the interferometer into the Align mode.
2. Align transmission element to interferometer (described in a previous section).
3. Place test part in the interferometer test beam.

   Minimize the space between the interferometer and the part being tested to reduce the impact of air turbulence.
4. If a spot from the test part is not visible on the Live Display make large adjustments to tip and tilt until you see the spot.
5. Align test part to the transmission flat by turning the tip and tilt knobs to move the second spot over the top of the first spot. When the two spots are perfectly superimposed they disappear.

Aligning the Test Part to the Interferometer
Example Live Display Image

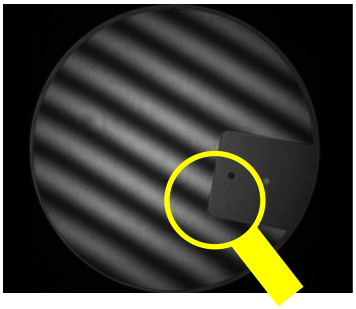


For a vertical configuration use the 5-axis Stage's tip and tilt knobs. For the horizontal configuration use the Adjustable Mount's tip and tilt knobs.

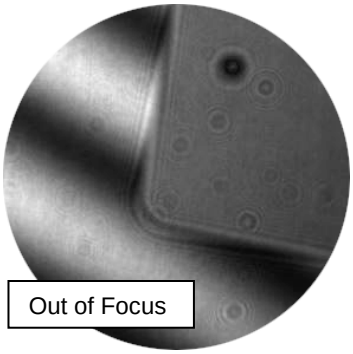
6. Press the Remote ALIGN/VIEW button so the interferometer is in the View mode.
7. If necessary, adjust the zoom function using the ZOOM buttons on the Remote until the section of the test surface that you want to examine fills as much of the Live Display's screen as possible.

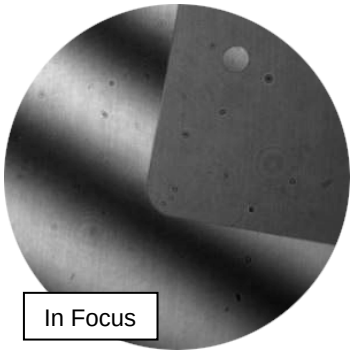
8. Position the Alignment Flag (or a piece of paper) in the field of view, close to the surface being tested. This provides a clean edge on which you can focus. (The area near the flag is enlarged for clarity.)

Using an Alignment Flag as a Focus Aid



Live Display Image



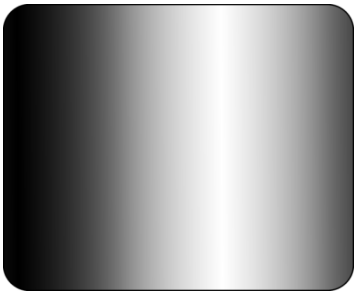


9. Fine-tune the test part tip and tilt to minimize (null) the number of fringes.

   Check to ensure that the system is in the correct operation mode for the part you are measuring.

10. Click the Measure button to make a measurement.

Example Nulled Fringe Pattern



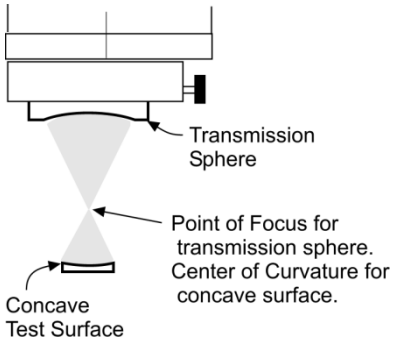
Testing a Concave Surface

Required Equipment:

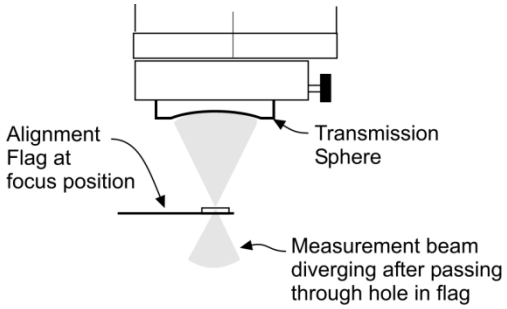
- Transmission Sphere (selected for coverage of test surface)
- 5-axis Stage (for vertical configuration)
- 5-Axis Mount (stage) (for horizontal configuration)
- Alignment Flag

1. Press the Remote ALIGN/VIEW button to put the interferometer into the Align mode.
2. Align transmission element to interferometer (described in a previous section).
3. Position an Alignment Flag in the beam just in front of the transmission sphere. Slowly move the Alignment Flag away from the interferometer to get an idea of the shape of the beam. As the beam leaves the interferometer it comes to focus and then diverges.
4. Position the Flag such that the measurement beam appears as a point of light on the flag. This is the beam's point of focus.

Positioning a Concave Test Part



Positioning the Alignment Flag



5. Adjust the Alignment Flag so the point of light passes through the hole in the flag.
6. Place the spherical test part on the stage just behind the Alignment Flag in the diverging portion of the test beam.
7. Move the part stage straight away from the interferometer until the measurement beam reflected from it comes to a point of light on the back of the Alignment Flag.
8. Adjust the lateral positioning of the spherical test part so the point of light passes through the hole in the Alignment Flag. The beam reflected from the test surface should appear as a bright dot on the Live Display. Remove the Alignment Flag from the test area.

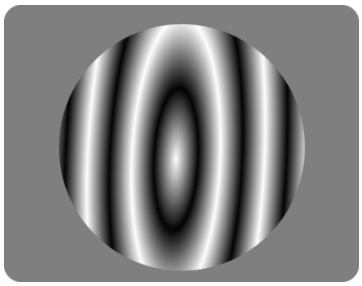
For a vertical configuration use the 5-axis Stage's X and Y knobs. For the horizontal configuration use the 5-Axis Mount's X and Y knobs.

9. Carefully adjust the Z position of the part stage until the dot of light on the Live Display align screen is as small as possible.

   For a vertical configuration use the 5-axis Stage's Fine Z control. For the horizontal configuration use the 5-Axis Mount's Z knob.

10. Fine-tune the stage's X and Y axis controls until the dot of light is superimposed on the crosshairs.
11. Press the Remote ALIGN/VIEW button to put the interferometer into the View mode. A fringe pattern should be visible on the Live Display.
12. If the fringe pattern consists of concentric rings, turn the Z control in the direction that makes the fringe rings appear to move toward the center of the screen. Continue to adjust the z axis until the fringes are as straight as possible.

Example Concave Fringe Pattern



13. Fine-tune the stage's X and Y axis controls to minimize (null) the number of fringes. You may also have to fine-tune the Z axis control to keep the fringes straight.

    Check to ensure that the system is in the correct operation mode for the part you are measuring.

14. Click the Measure button to make a measurement.

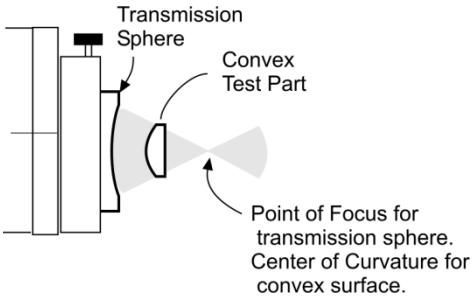
Testing a Convex Surface

Required Equipment:

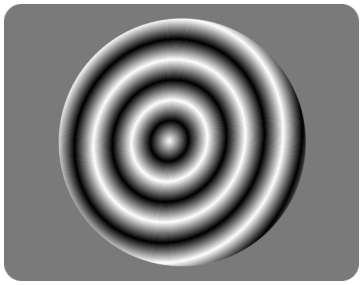
- Transmission Sphere (selected for coverage of test surface)
- 5-axis Stage (for vertical configuration)
- 5-Axis Mount (stage) (for horizontal configuration)

1. Press the Remote ALIGN/VIEW button to put the interferometer into Align mode.
2. Align transmission element to interferometer (described in a previous section).
3. Place the convex test part on the part stage.
4. Position the test surface as close as possible to the transmission sphere; then *slowly* pull the convex part straight away from the interferometer until you see a spot of light appear on the Live Display. This spot of light is the wavefront reflecting from the convex surface.

Positioning a Convex Test Part



Example Convex Fringe Pattern



5. Adjust the location of the part stage in the Z axis until the dot of light on the Live Display is as small as possible.

   For a vertical configuration use the 5-axis Stage's Coarse Z Crank. For the horizontal configuration move the entire 5-Axis Mount.

6. Fine-tune the X and Y axis controls on the part stage until the dot of light is superimposed on the crosshairs on the Live Display.

   For a vertical configuration use the 5-axis Stage's X and Y knobs. For the horizontal configuration use the 5-Axis Mount's X and Y knobs.

7. Press the Remote ALIGN/VIEW button to put the interferometer into the View mode. A fringe pattern should be visible on the Live Display.
8. Fine-tune the z axis position of the part stage until the fringes are as straight as possible.

   For a vertical configuration use the 5-axis Stage's Fine Z knob. For the horizontal configuration use the 5-Axis Mount's Z axis knob.

9. Fine-tune the stage's X and Y axis controls to minimize (null) the number of fringes. You may also have to fine-tune the Z axis control to keep the fringes straight.

   Check to ensure that the system is in the correct operation mode for the part you are measuring.

10. Click the Measure button to make a measurement.

Measuring Transmitted Wavefront Quality

Testing Transmitted Plano Wavefront

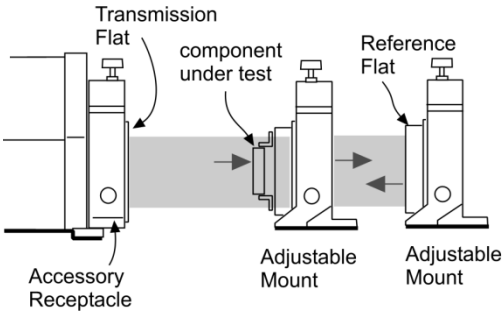
The simplest transmitted wavefront quality test is one involving a single plano element that has little or no wedge, typically a window of some type.

Required Equipment:

- Transmission Flat
- Reference Flat
- Two Adjustable Mounts
- Self Centering Element Holder (to hold plano optic)
- Alignment Flag

1. Press the Remote ALIGN/VIEW button to put the interferometer into the Align mode.
2. Align transmission element to interferometer (described in a previous section).
3. Place the Reference Flat in an Adjustable Mount.

Typical Transmitted Wavefront Setup



4. Position the Reference Flat so that it is within the interferometer's measurement beam and is as close as practicable to the Transmission Flat while leaving enough room to position the plano optic and its mount between them.
5. Adjust the tip and tilt of the reference flat until its corresponding bright spot on the alignment screen is superimposed on the intersection of the crosshairs.
6. Place the plano optic to be tested in a mount that allows tip and tilt adjustment. Position the mounted plano optic between the transmission flat and the reference flat.
7. Adjust the tip and tilt of the plano optic so that its corresponding bright spot on the alignment screen is near, but *not* superimposed on the intersection of the alignment crosshairs.

8. Press the Remote ALIGN/VIEW button to put the interferometer into the View mode. You should be able to see an interference pattern on the Live Display.

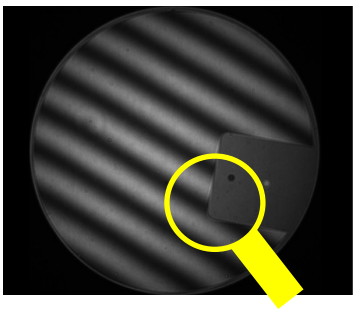
   To be sure the interference pattern is the result of transmitted wavefront and not the surface of the plano optic, place a piece of paper between the plano optic and the reference flat. If the paper blocks the interference pattern, the pattern is a result of transmitted wavefront.

9. If necessary, adjust the x-axis (side-to-side) position of the plano optic such that it (or the portion of it that you need to test) falls within the interferometer's measurement aperture. Watch the Live Display while making position adjustments.

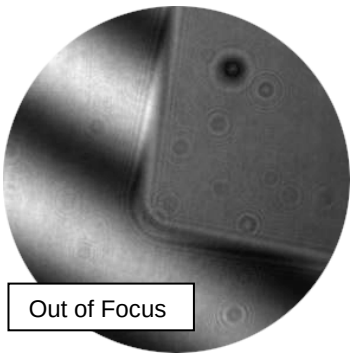
   You may want to temporarily switch back to the Align mode to make sure the bright dot from the test optic is still near the intersection of the crosshairs.

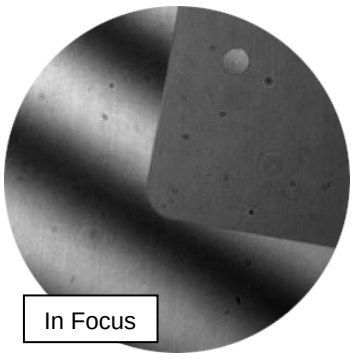
9. If necessary, adjust the zoom function until the section of the test surface that you want to examine fills as much of the Live Display screen as possible.
10. Position the Alignment Flag or a piece of paper in the field of view, close to the reference flat being tested. This provides a clean edge on which you can focus.
11. Using the FOCUS button on the Remote, adjust the focus so that the edges of the Alignment Flag are as sharp as possible. (The area near the flag is enlarged for clarity.)

Using an Alignment Flag as a Focus Aid



Live Display Image





12. Fine-tune the tip and tilt of the test surface to minimize (null) the number of fringes.

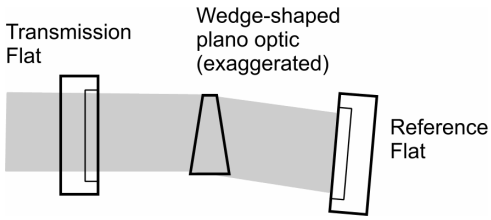
    Check to ensure that the system is in the correct operation mode for the part you are measuring.

13. Click the Measure button to make a measurement.

Testing Plano Optics with Wedge

Testing a wedge-shaped plano optic (one having sides that are not parallel to one another) is similar to testing one that is not wedge-shaped, except for a few special adjustments noted in the following paragraphs. The adjustments are necessary because the measurement beam changes direction slightly as it passes through the wedge-shaped optic.

Beam Passing Through Wedge Optic



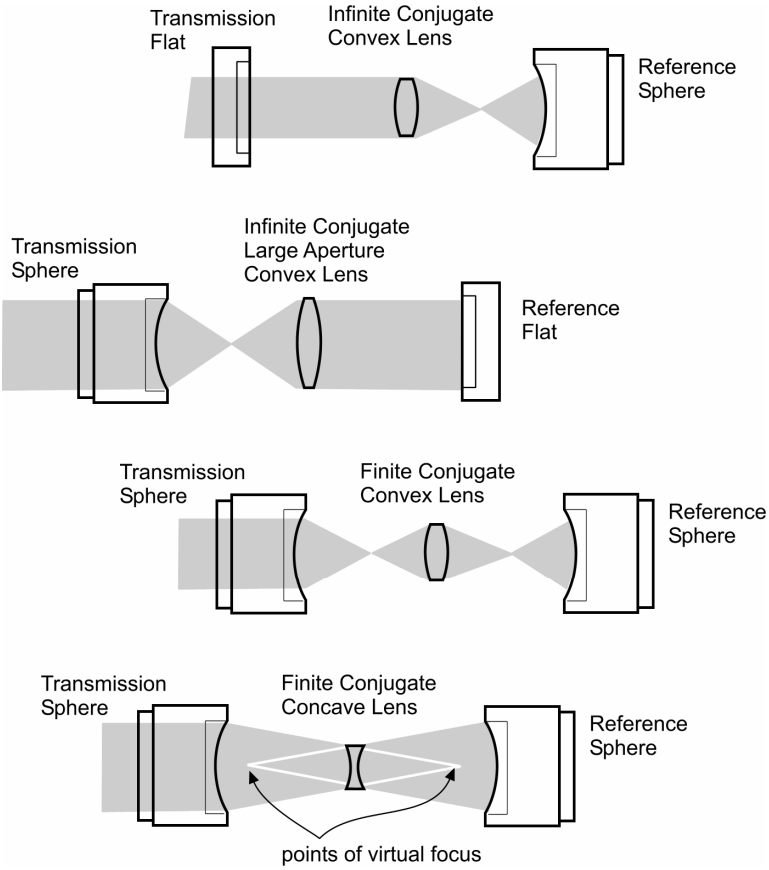
1. Perform steps 1 through 4 of the previous procedure.
2. Watch the Live Display as you place the test optic between the interferometer and the reference flat. Notice that the wavefronts reflected from the surfaces of the wedge optic show up as two bright dots on the alignment screen. (The distance between the dots depends on the amount of wedge in the optic.) Also, as you insert the test optic in the measurement beam, watch for the appearance of an additional bright dot on the Live Display. This new dot is the reflection off of the reference flat; it will remain stationary as you adjust the position of the wedge optic.
3. Adjust the tip and tilt of the wedge optic such that the two bright dots are equidistant from the intersection of the crosshairs. Adjust the tip and tilt of the reference flat until the *new* bright dot is superimposed on the alignment crosshairs.
4. Continue with step 7 of the previous procedure.

Testing Lens Systems

In this section, any component tested for transmitted wavefront quality will be referred to as a “lens system,” regardless of whether it is comprised of a single spherical element or group of elements.

Creating a test setup for a lens system requires knowledge of its design and intended usage. Selecting the proper transmission element and reference surface and aligning the optical axes of the lens system, interferometer, and reference sphere are crucial to the success of the test. The method for doing these things is almost entirely dependent on the lens system being tested, and is therefore beyond the scope of this manual. The following drawing shows some possible test setup diagrams. For assistance with specific testing needs, contact ZYGO.

Typical Transmitted Wavefront of Lens Systems



Maintenance and Service

Chapter 4

If you keep things clean and handle equipment with care you'll find that your ZYGO instrument requires very little maintenance.

Maintaining the Interferometer

The interferometer is virtually maintenance free if operated in a relatively clean environment. The general maintenance procedures covered in this chapter include equipment cleaning and cleaning optical components. A regimen of good general care will prolong the life of the equipment.

To clean the exterior of the interferometer use a commercially available, mild cleanser and a soft cloth to remove dust and fingerprints from the side and front panel of the unit.

For maintenance and service on the computer components refer to the original manufacturer's documentation. The computer components include the computer, monitors, mouse, keyboard, and accessories, such as a printer.

Replacement of any non-ZYGO components, such as a keyboard, monitor, or printer, must be done with CE compliant components.

General Care

The components used in your ZYGO 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 soap solution.
- *Handle Equipment Carefully*
  The instrument is designed to provide precision measurements. Transmission elements are precision optics; handle them only when necessary. Keep unused optics stored in their protective containers. Clean optics only when absolutely necessary following the procedures in this chapter.

Maintenance Schedule

Item	Interval	Comments
Clean exterior surfaces of equipment	Only when needed	The interval depends upon the cleanliness of work environment.
Clean Optical Components	Only when needed	Optical surfaces should only be cleaned when dirt or dust is noticeable.

Cleaning External Surfaces

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

Cleaning Optics

Whenever a precision optic is cleaned there is chance that the surface may be damaged. Many of the optics used with the interferometer are coated. Coated optics are easily damaged by improper or unnecessary cleaning. The need for cleaning can be minimized by proper handling techniques; returning optics to their protective storage containers when not in use, and by keeping the environment clean.

Never attempt to clean optics within the instrument since system performance may be impaired.

Precautions When Cleaning Optics

Warnings!

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 wear lab gloves.

Consult the local agency in your area for requirements concerning proper disposal of cleaning waste.

Recommended Cleaning Materials

Item	Comments
Polyethylene lab gloves	Wear to prevent contamination of surfaces and to 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 must 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 contaminants fixed to the optical surface. Use a mild, neutral 1% soap solution or lens cleaner to remove oily contaminants.

Recommended Cleaning Procedures

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 additional wiping, use a new swab or tissue.
Fingerprints, oil, and water spots.  *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 additional wiping, 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.

Troubleshooting

If you should encounter any difficulty while operating your interferometer, refer to the chart below. Quite often it is a simple problem and can be fixed quickly. If you cannot resolve a problem using this chart, contact ZYGO Customer Support.

Problem	Possible Cause & Correction
Alignment target not displayed on monitor.	Interferometer power switch is in the Off position. Move to the On (1) position. Check the power manager or power strip. Remote is in incorrect mode. Press button on the remote to go to Align mode. Remote is not connected. Check interferometer connector panel. Monitor on/off switch is in off position. Move it to on position. Check the power manager. Video monitor cable is disconnected from the interferometer. Check monitor and interferometer connector panels.
Hardware error message.	Computer equipment was reset, but the instrument was not. Restart both the computer and the instrument. If this does not correct the problem contact ZYGO.
Interference pattern irregularity— a circular pattern (or more than one) does not seem to be a feature of the test part.	This is a diffraction pattern that is imaged as an Airy Disk pattern. If the diffraction pattern is not in focus, the resulting pattern will not appear as a true Airy Disk. In either situation, the pattern does not represent any defect or feature of the part being measured. It is the result of two interrelated factors. The first is the nature of coherent laser light; the second is the inherent inconsistencies present in some of the system optics. This pattern, or artifact, may be present at the time of manufacture and is specified at <4 nm peak-to-valley. Please note that the presence of such patterns should not adversely affect the system's ability to meet the stated accuracy specifications of the instrument.
Interferogram not focused.	X, Y, or Z Axis knobs on stage may need adjustment. Adjust for fine-tuning. Interferometer camera may need replacement. Contact ZYGO.
Loss of laser light.	Beam Attenuator knob on interferometer is pulled out. Push in for laser emission. There is no power to the system. Check power manager and power switch (1/0) on interferometer.

Problem	Possible Cause & Correction
Interferogram not displayed on video monitor.	Interferometer power switch is in the 0 (off) position. Move to the 1 (on) position. Check power manager. Monitor power switch is in the off position. Move it to the on position. Check power manager power cord. Video Monitor not plugged into dual monitor video adapter or desktop not properly extended to secondary display. Video monitor power cord is disconnected. Check interferometer connector panel. Video monitor contrast and brightness controls are not adjusted correctly. Try adjusting both controls. Remote is in incorrect mode. Press button on the remote to go to View mode. Interferometer camera may need servicing; contact ZYGO.
Interferometer 1/0 (on/off) indicator not lit.	Interferometer power switch is Off. Turn to the On (1) position. There is no power to the system. Check power cord and power manager.
Non-uniform image field on live display.	Transmission element may not be aligned properly. Refer to the "Aligning the Transmission Element" section of Chapter 3. The Beam Attenuator is only pulled out part way. Check the position of the control.

Getting Service

Warning!
The equipment does not have any user-serviceable components. Service must be performed by ZYGO trained service personnel. Any attempt to service or repair equipment may void the warranty. Please contact ZYGO Customer Support.

Returning Equipment for Service

To return equipment to ZYGO, it is necessary to have a RA (return authorization) number. Contact ZYGO Customer Support for an RA number and instructions on packing and shipping equipment.

Do not return equipment to ZYGO without a RA Number. Equipment returned without a RA number is not accepted.

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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.

A. STANDARD PRODUCTS.

WARRANTY PERIOD 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.

POST WARRANTY TO 5 YEARS ZYGO will support all standard products for a period of five years after the sale of the last newly manufactured unit. As vendor supplied material components become unavailable during this period, ZYGO will create upgrade paths to replace obsolete components with more current replacements. These upgrades can include internal components, computers, and software.

5 TO 10 YEARS ZYGO will continue to support older products. Service methods may include modifying units when parts become available, upgrading a unit to allow peripherals in a more supportable configuration, or providing a current product that meets or exceeds the original units functionality.

GREATER THAN 10 YEARS Product is obsolete. Service and support will be performed on a best-efforts basis.

B. NON-STANDARD / CUSTOM PRODUCTS.

WARRANTY PERIOD ZYGO warrants that the products 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 cases of customer supplied materials, ZYGO warrants only the workmanship.

POST WARRANTY ZYGO will continue to support non-standard / custom products on a best effort basis after the new product warranty expires.

C. WARRANTY SERVICE.

ZYGO will provide service to return malfunctioning products to as shipped condition by repair or replacement (at ZYGO's option) of defective equipment at no cost to the Buyer. 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 that 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.

D. RETURNS.

Unused and undamaged products, in their original shipping containers, may be returned for credit within 30 days of receipt. All such returned products will be subject to a restocking fee equal to 35% of the purchase price. Custom products are not returnable.

E. EXCLUSIONS.

Warranty service does not include or apply to any product or part which, in ZYGO's judgment:

i. Has been repaired by others, improperly installed, altered, modified or damaged in any way.
ii. Malfunctions because the Buyer has failed to perform maintenance, calibration checks or use good operating procedures.
iii. Is expendable or consumable (such as panel lights, fuses, batteries, windows and filters) if such items were operable at the time of initial use.
iv. Requires replacement because of decomposition due to chemical action.
v. 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, ACCIDENT, REPAIRED OR ALTERED BY OTHER THAN SERVICE REPRESENTATIVES QUALIFIED BY ZYGO.

11/2002

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