

**ZMI Laser Head
P/N 6191-0460-XX
Operation Manual
OMP-0329B**



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MANUAL REVISION INFORMATION

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MANUAL NOTATIONS



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

Note: Provides helpful information.

ZYGO TECHNICAL SUPPORT

For help within the United States, Canada, and Mexico, please use the contacts listed below. For help in other countries, please contact your local Zygo representative.

Be sure to supply the instrument model and serial number, and the software version.



PHONE (860) 704-5191, Customer Support Center, 8 a.m. - 8 p.m. (EST)
(800) 994-6669, Zygo Corporation



FAX (860) 346-4188, 24 hours per day



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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 Corporation. Zygo warrants that the equipment purchased will be free from any defects in material and/or workmanship under normal operating conditions for a period of one year from the date of shipment.

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

WARRANTY SERVICE

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

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

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

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

RETURNS

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

EXCLUSIONS

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

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

- a. Has been repaired by others, improperly installed, altered, modified, or damaged in any way.
- b. Malfunctions because the customer has failed to perform maintenance, calibration checks or good operating procedures.
- c. Is expendable or consumable (such as 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

In This Chapter

- What This Manual Covers
- Description
- Laser Safety
- Electrical Safety
- Specifications

What This Manual Covers

This manual describes the Zygo Motion Interferometer (ZMI) Laser Head*, part number 6191-0460-XX. The manual makes the assumption that you are already familiar with interferometry. The Laser Head is part of a complete displacement measuring interferometer system, as shown in Figure 1-1.

It is broken down into two main chapters:

Chapter 1 Describes the Laser Head's features and specifications.

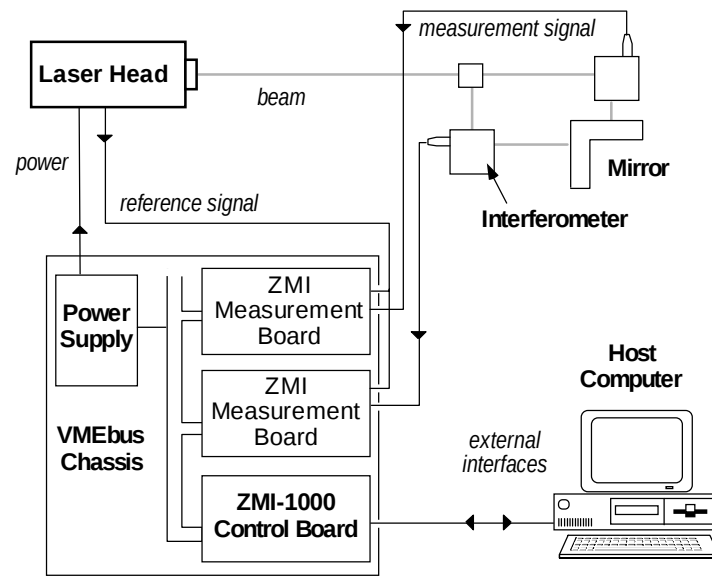
Chapter 2 Describes installing and aligning the Laser Head.

For information on other Zygo motion measurement components refer to their respective manuals.

DESCRIPTION

The Laser Head* is the heart of a Zygo motion measuring system. It uses a Helium-Neon frequency stabilized laser to generate a laser beam with two components that are collinear, orthogonally polarized, and with different frequencies. One frequency (F1) is vertically polarized and is 20 megahertz higher in frequency than the other (F2). The nominal vacuum wavelength of F1 is 632.991501 nanometers and F2 is 632.991528 nanometers. The Laser Head is shown in Figure 1-2.

*U.S. Patents 4,688,940 and 4,684,828. Foreign Patents Pending.



Typical Interferometer System
Figure 1-1

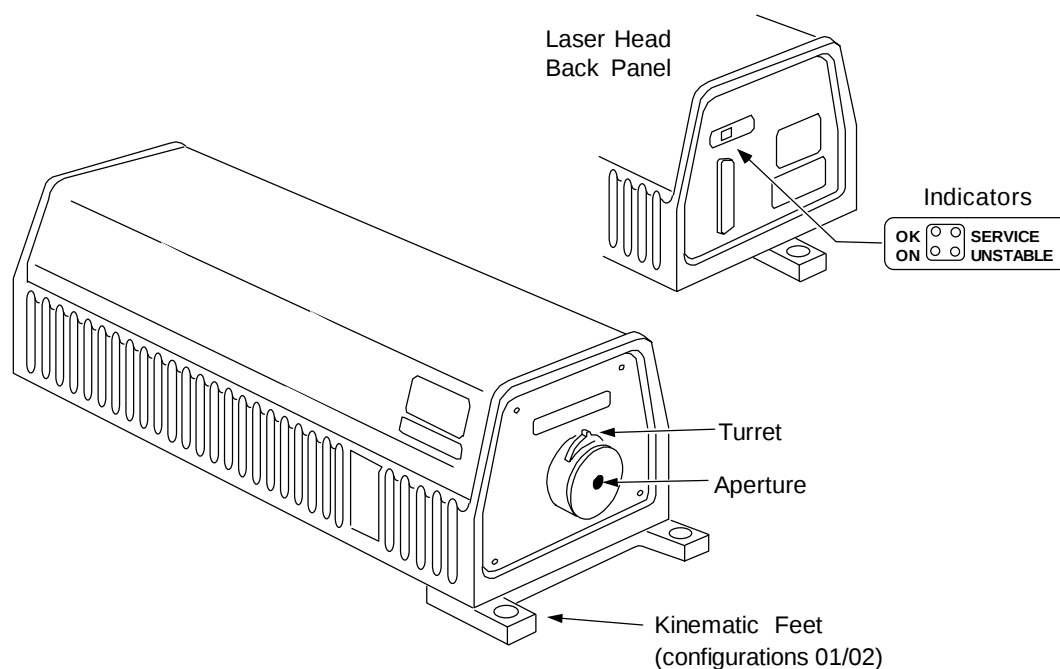
There are four Laser Head configurations, these are highlighted in Table 1-1.

<i>Configuration</i>	<i>Beam Size (mm)</i>	<i>Mounting Feet</i>
6191-0460-01	6	Kinematic
6191-0460-02	3	Kinematic
6191-0460-03	6	Fixed
6191-0460-04	3	Fixed

Table 1-1 Laser Head Configurations

The laser tube (the internal part of the Laser Head that generates the light beams) is thermally stabilized and requires a warm-up time. The laser beam exits the Laser Head through a three position aperture. The aperture contains a " turret" to switch the beam from full size, to no beam output, to small size.

The Laser Head is connected to a user-supplied ± 15 VDC power supply via the Laser Cable. The cable provides power for the laser and returns an electrical reference signal to measurement boards.



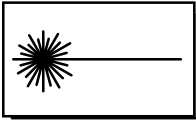
Laser Head
Figure 1-2

The Laser Head has four indicator lights on its rear panel, as shown in Figure 1-2. These indicators are explained in Table 1-2.

<i>Indicator</i>	<i>Color</i>	<i>Function</i>
OK	green	When lit the laser is warmed up to operating temperature and ready for use. It is off during warm-up.
ON	green	When lit power is being supplied to the laser and laser radiation may be emitted from the Laser Head's aperture.
SERVICE	yellow	When lit the Laser Head requires servicing. Contact Zygo Service Department.
UNSTABLE	yellow	When lit the laser is unstable; the laser wavelength exceeds a tolerance of approximately ± 0.01 ppm. It is normal for this light to be on during warm-up; when the laser head is warmed up, this light should remain off.

Table 1-2 Laser Head Indicator Lights

LASER SAFETY



Before operating the Laser Head, please read the following material to become familiar with safety controls, markings, and warnings.

The Laser Head emits visible red light. The external radiant intensity output by Laser Head is low; however, the intensity inside the Laser Head is greater. The external and internal radiation cannot burn or drill holes, even if a lens is used to focus the light. However, the laser light emitted by the laser should be treated with caution. It will not damage skin, but to protect your eyes, do not look directly into the laser beam or stare at its bright reflections.

Laser Safety Standards

The American National Standard for the Safe Use of Lasers (ANSI Z136.1-1986) classifies this laser product as Low Power - Class II (per Table A1), and provides reasonable and adequate guidelines for its safe use. The user and personnel responsible for the safe use of the Laser Head in the user's organization should consult this ANSI standard, available from:

American National Standards Institute
1430 Broadway
New York, New York 10018

The Laser Head conforms to the National Center for Devices and Radiological Health (NCDRH) of the Food and Drug Administration and to international laser safety regulations.

To encourage proper laser safety and to abide by the above laser safety regulations, Zygo supplies the information listed on the next page. To locate the controls and the labels listed on the next page, refer to Figure 1-3.

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

Emission Duration: more than 0.25 second

Radiant Power: <1 milliwatt

Wavelength: 632.8 nanometers

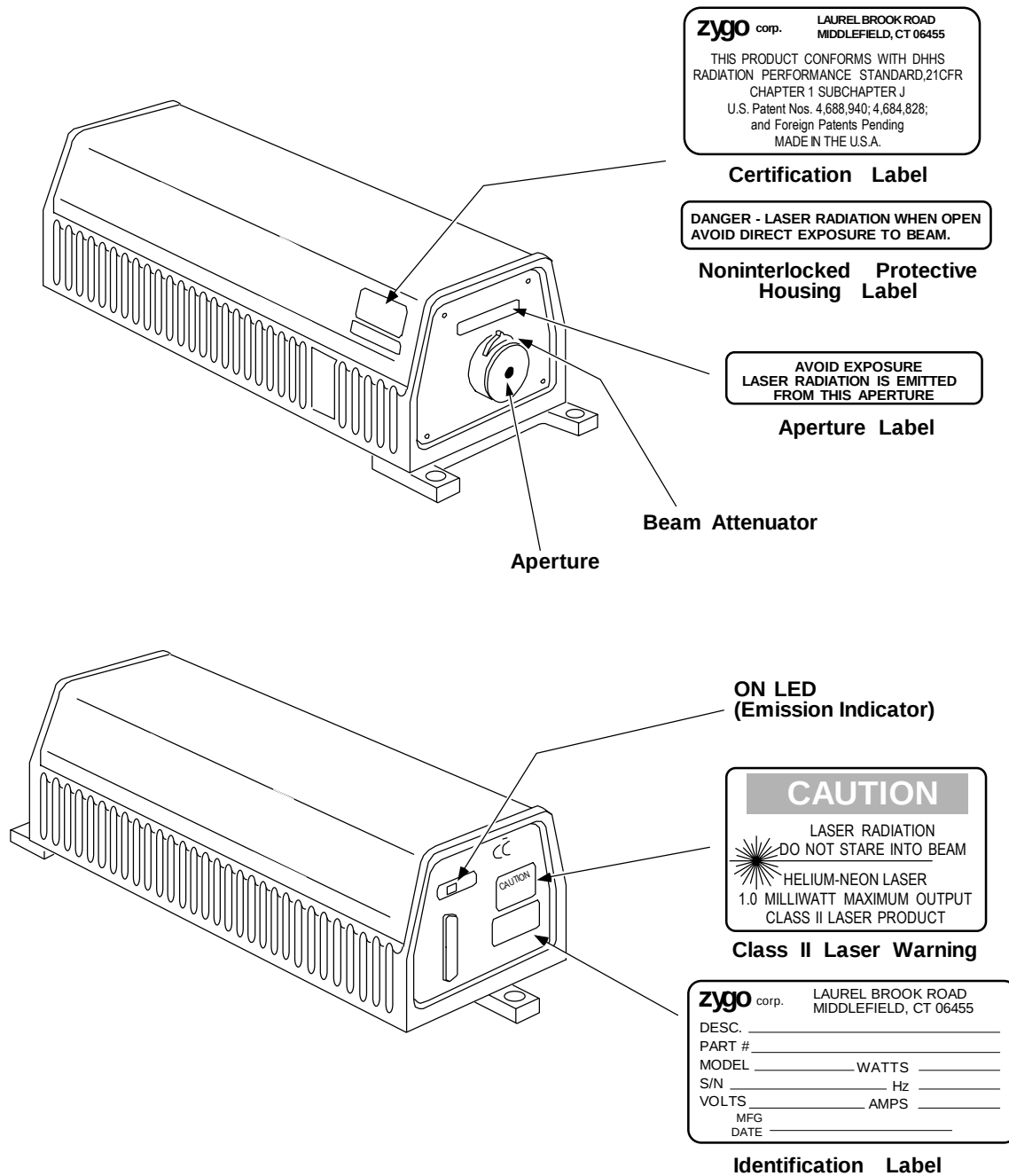
Laser Emission Control Devices

<i>Device</i>	<i>Function</i>
Rear Panel ON Indicator (Green LED)	When lit, indicates that power is being supplied to the laser, and that Class II laser radiation may be emitted from the Laser Head's aperture.
Beam Attenuator	When positioned, blocks the laser beam from being emitted from the instrument.

Laser Safety Labels

<i>Label</i>	<i>Purpose</i>
Class II Laser Warning	Federal requirement for Class II lasers.
Aperture	Labels the instrument's aperture through which laser radiation is emitted.
Noninterlocked Protective Housing	Reminds you that when the covers are removed, and the system is turned on, Class II laser radiation is being emitted.
Certification	Shows that Zygo Corporation has conformed to the DHHS standard.
Identification	Provides information about the instrument - description, part number, model, etc...

ZMI Laser Head



Laser Head Safety Controls and Labels
Figure 1-3

ELECTRICAL SAFETY

The Laser Head must be provided with earth ground through the Laser Cable. The Laser Head is electrically isolated from its mounting surface.

**WARNING!**

Ensure that the Laser Head is properly grounded.

DO NOT connect cables, install, or repair the Laser Head with power on.

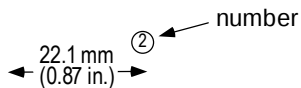
DO NOT attempt to repair or service the Laser Head.

Voltages from 1,800 to 12,000 volts may be present on the anode of the laser tube.

SPECIFICATIONS

The general specifications of the Laser Head are shown on the next two pages. For specifications on cables refer to the ZMI Cable Guide, OMP-0333.

Dimensions are tagged with numbers as shown here:



The numbers denote the tolerance of the dimension as follows:

<i>Number</i>	<i>Millimeters</i>	<i>Inches</i>
1	± 0.13	± 0.005
2	± 0.25	± 0.010
3	± 0.38	± 0.015
4	± 0.51	± 0.020
5	± 0.64	± 0.025
6	± 0.79	± 0.031
7	± 1.27	± 0.050
8	± 2.16	± 0.085

ZMI Laser Head P/N 6191-0460-XX

Physical Characteristics:

Dimensions: See Figure
 Weight: 5.5 Kilograms (12.0 lb)
 Nominal Cable Clearance: 135 mm (5.3 in.)

Electrical:

Power Requirements (max.):
 + 15 VDC +0.5V, -0V @ 1.4 A
 - 15 VDC +0V, -0.5V @ 0.8 A
 Power Dissipation (max.):
 27 watts during operation
 32 watts peak during warm-up
 Warmup Time: less than 30 minutes

Laser Beam Characteristics:

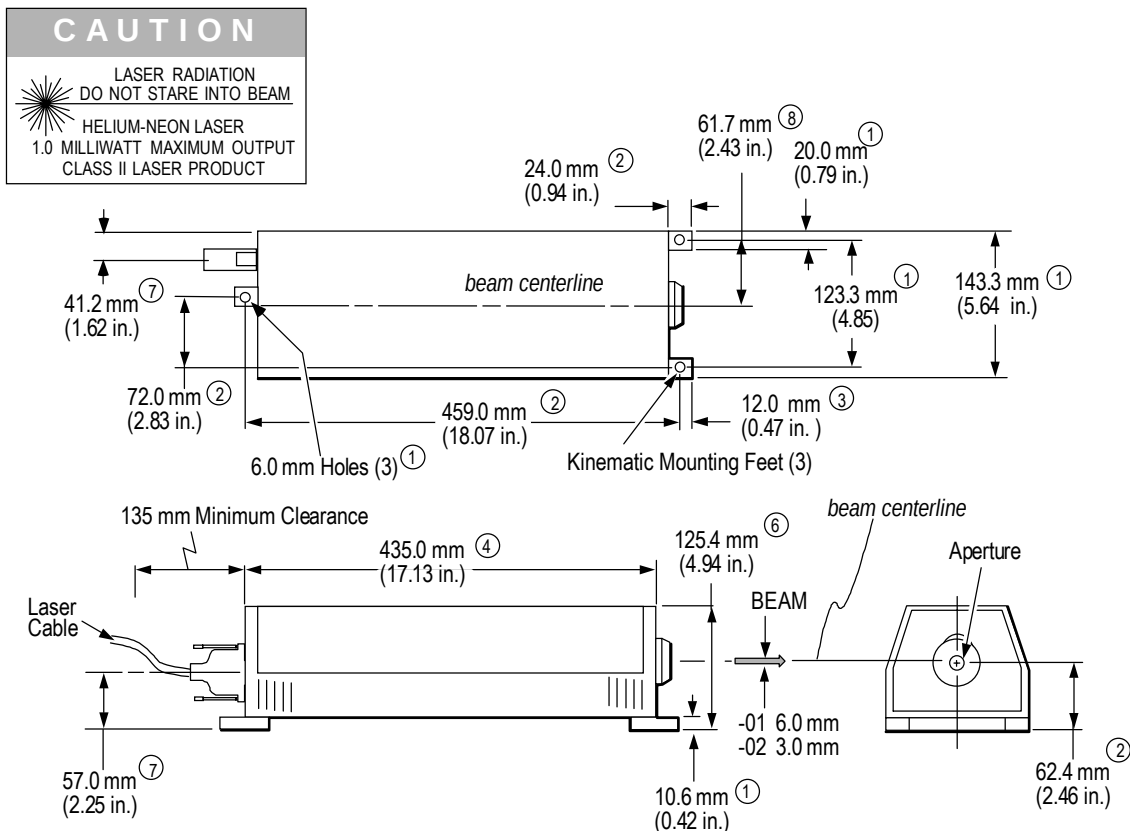
Type: Helium-Neon, Continuous Wave,
 Two-Frequency
 Maximum Beam Power Output: < 1 milliwatt
 Minimum Beam Power Output: >300 microwatts
 Frequency Difference: 20 MHz $\pm$ 1600 Hz
 Maximum Power Difference Between Two
 Frequency Components: 20% of total power
 Beam Diameter:
 6 millimeters (0.24 in.) -01/-03
 3 millimeters (0.12 in.) -02/-04

Laser Beam Characteristics (continued):

Usable Beam Length:
 25 meters (82 ft) -01/-03
 2 meters (6.6 ft) -02/-04
 Beam Pointing Stability: < 0.1 arc sec/°C ambient
 temperature change after warmup
 Nominal Vacuum Wavelength:
 F1: 632.991501 nm (vertical polarization)
 F2: 632.991528 nm (horizontal polarization)
 (horizontal polarization is parallel to the Laser
 Head mounting surface)
 Vacuum Wavelength Lifetime Accuracy: $\pm$ 0.1 ppm
 Vacuum Wavelength Stability: $\pm$ 0.01 ppm/24 hours
 DHHS Laser Safety Classification: Class II laser
 product conforming to NCDRH regulations

Environmental:

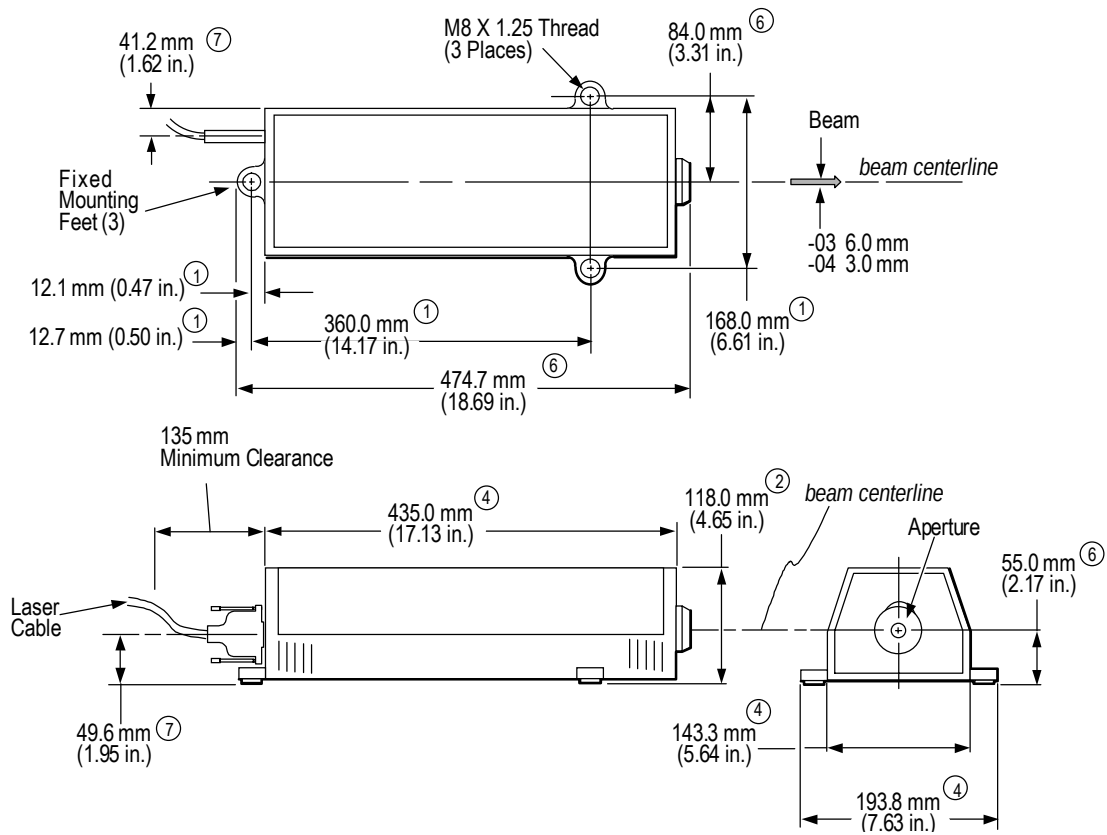
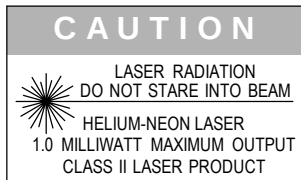
Operating Temperature: 10 to 30°C
 Non-operating Temperature: -40 to 75°C
 Operating Humidity: 0 to 90% (non-condensing)
 Non-operating Humidity:
 0 to 90% (non-condensing)
 Shock: (non-operating) 11 milliseconds 40 G
 shock on each of three orthogonal axes.



Dimensions shown above pertain to -01/-02 configurations with Kinematic Mounting Feet

ZMI Laser Head P/N 6191-0460-XX (continued)

Refer to specifications on previous page.



Dimensions shown above pertain to -03/-04 configurations without Kinematic Mounting Feet

Chapter 2

INSTALLATION

In This Chapter

- Checklist
- Unpacking
- Installing the Laser Head
- Aligning the Laser Head

CHECKLIST

The following checklist is provided to assist you in installing your Laser Head. Use the checklist as a summary of the installation procedures.

- ☐ Inspect all packages for signs of shipping damage. Report any damage to the carrier and to the Zygo Service Department.
- ☐ Verify that the mounting location for the Laser Head is true, solid, and that the beam height is located properly.
- ☐ Secure the Laser Head in position using kinematic mounting techniques.
- ☐ Connect the cable to the Laser Head. Verify that the Laser Head is properly grounded.
- ☐ For customized applications, review the connector pin assignments.
- ☐ Align the Laser Head to the measurement axes.

UNPACKING

Inspect all packages for signs of shipping damage. Report any damage to the carrier and notify your Zygo representative. If necessary, retain the shipping material for the carrier's inspection.

Make sure that your order is complete. The following parts are included with the Laser Head:

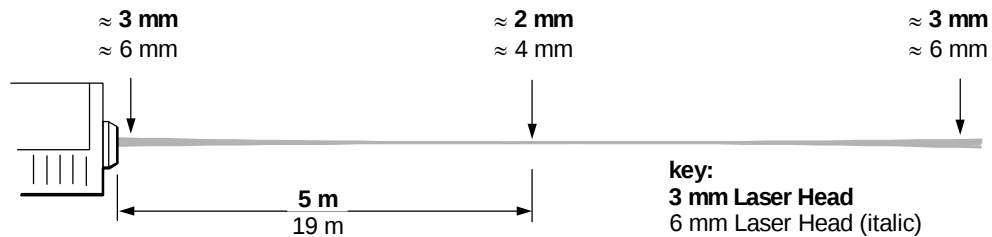
<i>Part</i>	<i>Laser Head 6191-0460-01/02</i>	<i>Laser Head 6191-0460-03/04</i>
Alignment Card	X	X
Mounting Kit		X

Cabling is supplied separately. Refer to the ZMI Cable Guide, OMP-0333, for a sample of the cable options available from Zygo.

INSTALLING THE LASER HEAD

The Laser Head can be mounted in any orientation as long as it is positioned to direct the beam into the optics parallel or perpendicular to the application's measurement axes. The Laser Head is attached to the mounting surface with bolts through its three mounting holes.

Due to Gaussian characteristics of the laser beam, the beam diameter varies as a function of distance from the Laser Head; see the following drawing. This phenomenon does not impact most applications; however, it may cause a signal efficiency loss when there are unequal test and measurement paths in the interferometer.



The Laser Head should be mounted such that the output beam is centered in the optical component(s) aperture, as the mounting holes do not allow for height adjustment. Allow 50 millimeters clearance around the Laser Head for access and 135 millimeters at the back for cable access. Interferometers should not be positioned too close to the Laser Head because the Laser Head dissipates heat.

1. If necessary, drill and tap holes in the mounting surface, spaced for the Laser Head mounting holes, as shown on the specification pages in Chapter 1.
2. Remove the Laser Head from the shipping container and place it in position on the mounting surface.

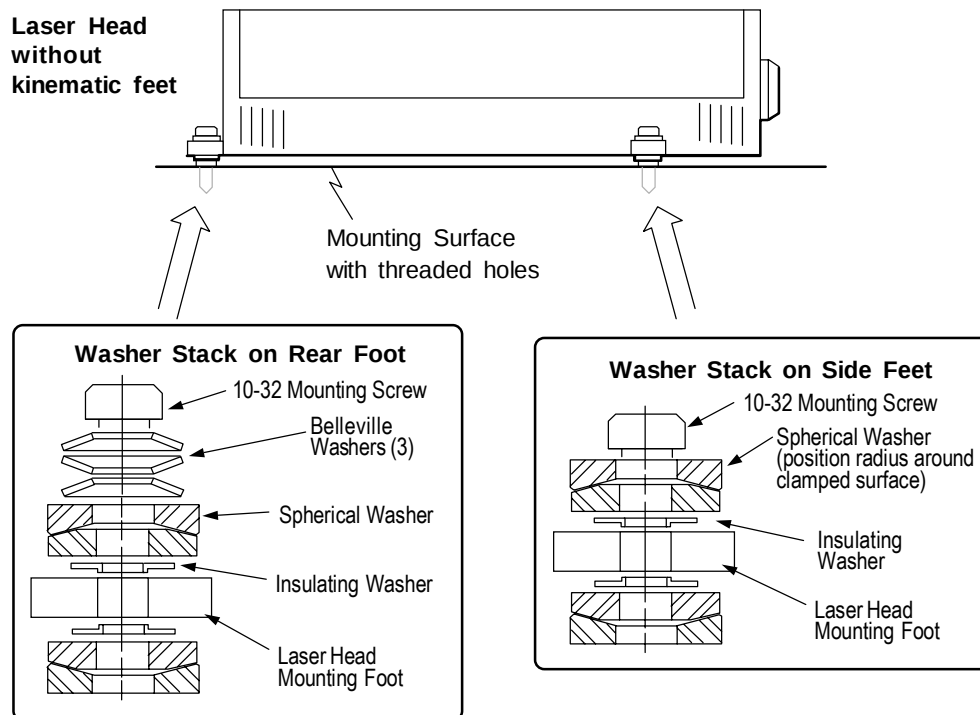


WARNING!

Incorrectly mounting the Laser Head can cause degradation of the laser beam. Ensure that the mounting technique used for the Laser Head does not introduce stresses. This caution especially applies to the Laser Head configurations with fixed mounting feet.

3. For Laser Head configurations with kinematic feet, insert M5 or 10-32 bolts through each mounting hole and tighten the bolts.

4. For Laser Head configurations with fixed feet, use the mounting kit included with the Laser Head, as shown in Figure 2-1. To secure the Laser Head:
 - a. Place the insulating washers and spherical washers around each foot of the Laser Head.
 - b. At the rear foot, stack the Belleville washers on top of the spherical washers.
 - c. Insert the 10-32 mounting screws through each washer stack.
 - d. Tighten the rear foot mounting screw 1/4-turn past the point when the screw contacts the Belleville washers.
 - e. Torque the two side screws to 40 in-lb (5 N•m).



Mounting Kit Detail
Figure 2-1

ZMI Laser Head

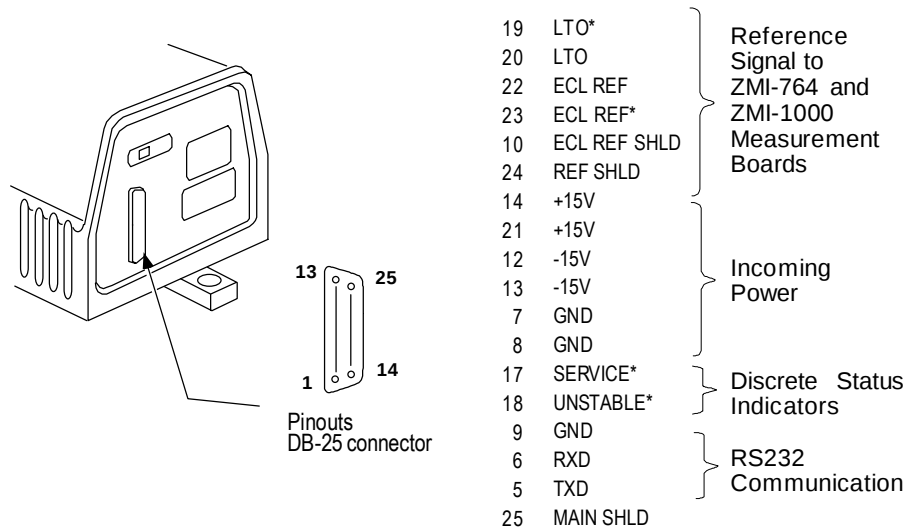
5. Verify that the Laser Head is grounded through the cable connection and not the Laser Head enclosure or feet.



WARNING!

The Laser Head feet and enclosure should be isolated from earth ground. The ZMI Laser Head, configurations 01 and 02, have nonconductive feet. Laser Head configurations 03 and 04 have conductive feet; ensure that the feet are not grounded.

6. Connect cabling to the Laser Head to supply the head with ± 15 volts and to return the reference signal to the Measurement Boards. The pinout of the Laser Head connector is shown in Figure 2-2.

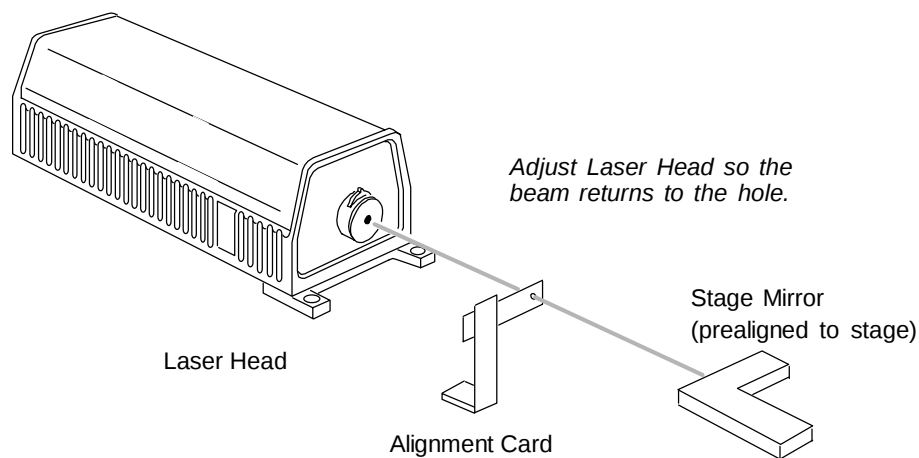


Laser Head Connector Pinout
Figure 2-2

ALIGNING THE LASER HEAD

The following procedure describes the alignment of a Laser Head for a typical application. Your application may use a different reflector than a stage mirror.

1. Align the plane (stage) mirror to the stage. The plane mirror surfaces should be perpendicular to each other, to their direction of travel, and to the reference plane on which the interferometer is mounted.
2. Align the *Laser Head* so that its output beam is perpendicular to the plane mirror. To do this, place the alignment card in front of the Laser Head so the beam goes through the pinhole in the card and reflects off of the moving reflective optic element back to the same hole. Check that the beam returns to the hole when the stage is moved to its farthest positions. Refer to Figure 2-3.



Laser Head Alignment
Figure 2-3

Chapter 3

MAINTENANCE AND TECHNICAL SUPPORT

LASER HEAD MAINTENANCE

The Laser Head is maintenance-free.

Note: DO NOT remove the Laser Head cover; all the internal components are non-serviceable. Removing the cover voids the warranty.

TECHNICAL SUPPORT

If you have difficulties, please refer to the provided manuals. They are designed to help you through the most common problems. If you still have questions or need assistance, contact the Zygo Service Department directly. Zygo's telephone numbers and address are located in the front of this manual.

Preparing for Technical Support

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

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

Returning Equipment to Zygo

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

1. Have the following information ready when requesting an RA number:
 - The equipment's serial number.
 - A description of the problem and the sequence of events that led up to your discovering the problem.
 - Your company's name and complete shipping address.
2. Contact Zygo by telephone.
3. Describe the problem. If it is necessary to return the equipment, we will provide an RA number. Adhere to the Laser Head shipping suggestions.

Laser Head Shipping Instructions

Pack the Laser Head securely to prevent any damage in shipping. Use the original shipping container when possible.

1. Turn off power, disconnect any cables from the Laser Head, and remove any leveling or mounting screws from the three mounting feet.
2. Place the Laser Head in a plastic bag, with the aperture end first. Securely tape the bag closed.
3. Place the original foam end caps onto the ends of the Laser Head, then put the Laser Head into the shipping container. Do not reuse the end caps if they are torn or if they have been used more than two times. If this is the case, you should replace the end caps with new packing material.
4. Include the RA number on the container and on any correspondence.

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