7970 Nd:YAG Laser

and

7901 Nd:YAG Laser

Operator Manual

COHERENT®

3270 West Bayshore Road
P.O. Box 10122
Palo Alto, CA 94303
(415) 858-2250

Please note that while every effort has been made to ensure that the data given in this document is accurate, the information, figures, illustrations, tables, specifications and schematics contained herein are subject to change without notice.

Please direct all inquiries regarding this manual to:

Coherent, Inc.
Technical Publications B-24
3270 West Bayshore Road
Palo Alto, California 94303
(415) 852-3873

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Aiming Instructions, formerly located in Section 2.6.6 of this manual, have been moved to Section 3 "Directions For Use" item number 6 "Aiming Instructions."

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Section 1

Introduction

How Should I Use This Manual?

Nd:YAG lasers generate a highly concentrated, invisible beam of light which can be dangerous if improperly used. This entire manual should be carefully read and comprehended before operation of the laser system. If you have questions regarding your laser system, contact Coherent Service (see Section 7, "Sales and Service Offices").

This Operator Manual is divided into eight sections, plus a Table of Contents and an Index:

- Section 1 "Introduction", acquaints you with the 7970 and 7901 Nd:YAG laser systems; and, this operator manual. It includes an overview of the manual sections, Symbols Used in This Manual, 7970 and 7901 System Differences, Theory of Nd:YAG Operation, Site Preparation, and Room Layout.

- Section 2 "Safety", provides important information regarding the safe use of your laser system.

- Section 3 "Indications For Use", discusses surgical procedures with the Coherent System 7970 Nd:YAG and 7901 Nd:YAG ophthalmic lasers. The systems are indicated for discission of the posterior capsule of the eye (posterior capsulotomy) and for discission of pupillary membranes (pupillary membranectomy). Section 2 "Indications For Use: Posterior Capsulotomy and Pupillary Membranectomy" introduces these procedures. The 7970 and 7901 are also indicated for iridotomy, which is discussed in Section 2 "Indications For Use: Iridotomy." A bibliography is also furnished for each of the indications.

- Section 4 "Instrument Description", provides a general introduction to the three main components of the laser systems...the Slit Lamp and Optics Module; the Control Panel; and the Electronics Module. Section 4 also describes the System Controls and Indicators; catalogs Accessory Equipment; and System Specifications.

- Section 5 "Operation", describes system operation. Topics include: Patient Preparation, System Alignment, System Turn-on, Treatment Procedure, System Turn-off and Language Selection.

- Section 6 "Maintenance", details system maintenance. Subjects include: Routine Maintenance, Cleanliness of Slit Lamp and Contact Lenses, Optical Alignment Verification, Energy Calibration, Troubleshooting Guide, and Service Error Codes.

- Section 7 "Customer Service", details the product warranty and provides a list of Coherent Sales and Service Offices.

- Section 8 "Errata", is used for retaining records of manual revisions. If it becomes necessary for Coherent to update a part of your manual, you will be sent the replacement pages along with a "Errata List." The Errata List will instruct you to remove specific pages from the manual and substitute them with the replacement pages. You will also be instructed to place the Errata List in the Errata section. This is done as a future reference should a question arise concerning the revision level of your manual.

  This section also contains two identical, postage paid (if mailed in the United States) forms. The forms are for institutions who wish to designate an individual or department as the "contact" for any future updates regarding this manual. The intent is to deliver the manual updates to the right person/location without delay.

Thoroughly read and comprehend this entire manual. If at a later date you need to reference a specific item, use the Index as a guide to information contained in this manual. If you need to review general concepts, refer to the Table of Contents or the following "Road Map Table."

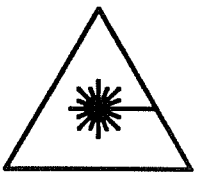
If you want to	*Go to*
Review the safety information	Section 2 "Safety"
Review clinical applications	Section 3 "Indications For Use"
Review the components of the laser system	Section 4 "Instrument Description"
Review how to operate the laser system	Section 5 "Operation"
Review how to maintain the laser system	Section 6 "Maintenance"
Review your warranty or contact Coherent	Section 7 "Customer Service"
If you wish to specify or change the manual contact person	Section 8 "Errata"

Symbols Used in This Manual

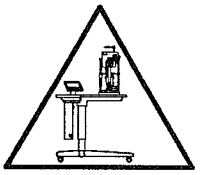
Bulleted "•" lists provide information but are not procedural steps. Numbered lists "1." indicate a procedure with sequential steps (with the exception of Section 3 "Indications For Use" where numbered lists are used for information and procedural steps).

The international caution/warning symbol (right) is intended to alert the operator to important safety considerations.

The coherent radiation symbol (right) is intended to warn the operator of the possibility of exposure to hazardous visible and invisible laser radiation.



The laser system caution symbol (right) is intended to alert the operator to important operating and maintenance instructions.



7970 and 7901 System Differences

This manual covers both the 7901 and the 7970 because of the essential equivalence of these Nd:YAG laser systems. There are differences between them, primarily due to different slit lamps, the power table, and the photocoagulator subsystem typically included in the 7901 configuration.

Also, more recent systems use a five step magnification changer; two and three step magnification changers were available previously.

Theory of Nd:YAG Laser Operation

The Coherent 7970 and 7901 Nd:YAG lasers provide the physician with a precise means for performing ophthalmic surgical procedures. The design and manufacture of the 7970 and 7901 are a result of the expertise Coherent has gained through years of experience with medical laser devices.

The Nd:YAG laser produces a beam of infrared light (1064 nanometers wavelength). Argon and krypton ophthalmic surgical lasers use heat to alter tissue by photocoagulation. The Nd:YAG laser, unlike argon and krypton, is not a photocoagulator but rather a photodisrupter or optical scalpel. The Nd:YAG laser concentrates an amount of energy on an extremely small focal point sufficient to create a plasma and disrupt tissue.

The term LASER is an acronym which means "Light Amplification by Stimulated Emission of Radiation." The basis of the lasing phenomenon is the ability of photons (light energy) to stimulate the emission of other

photons, each having the same wavelength and direction of travel.

All conventional lasers include three fundamental elements: a lasing medium which provides atoms, ions, or molecules that support light amplification; an energy source that excites the medium; and an optical resonator that provides feedback of the amplified light. The Nd:YAG lasing medium is a man-made crystal rod of Neodymium-doped Yttrium-Aluminum-Garnet (Nd:YAG). The energy source that excites this Nd:YAG crystal is a high-intensity flash lamp. The optical resonator is comprised of precisely aligned mirrors at each end of the Nd:YAG rod. One of these mirrors is 100 percent reflective at 1064 nanometers, while the other reflects only a prescribed portion of the light (such as 30 percent) and allows the remainder to pass through.

Within the resonator, or cavity, emitted photons travel back and forth between highly polished mirrors. When a photon passes close to an excited atom, the atom may be stimulated to emit a photon that is identical in wavelength, phase and spatial coherence to the first. This amplification process continues, increasing the number of active photons in a pulse.

The laser pulse builds in the resonating cavity as it makes hundreds of round trips between the two mirrors. On each round trip, some of the energy is reflected back into the cavity allowing the pulse to gain energy exponentially, ultimately producing an extremely brief but dramatically energetic pulse.

The Nd:YAG 1064 nanometer wavelength is invisible to the eye and is not blocked by common glass, plastic, or the visibly clear portions of the eye. Because Nd:YAG laser light is pulsed, as well as invisible, the 7970 and 7901 use a continuous, visible red helium neon (HeNe) laser beam for aiming purposes.

The focal point of the Nd:YAG working beam is set posterior to that of the HeNe aiming beam, providing an optimal energy density for cutting tissue.

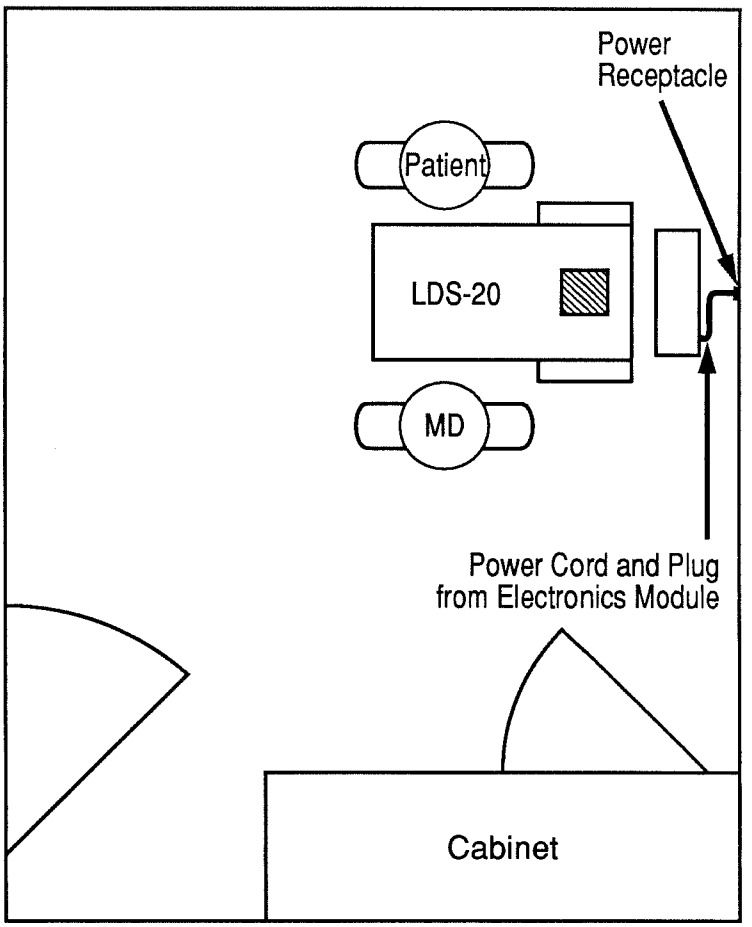
Site Preparation

The following specifications should provide the customer with adequate information to prepare a facility for the installation of the 7970 or 7901 Nd:YAG laser system. Please review the specifications and make the necessary preparations in order that your laser may be installed upon receipt.

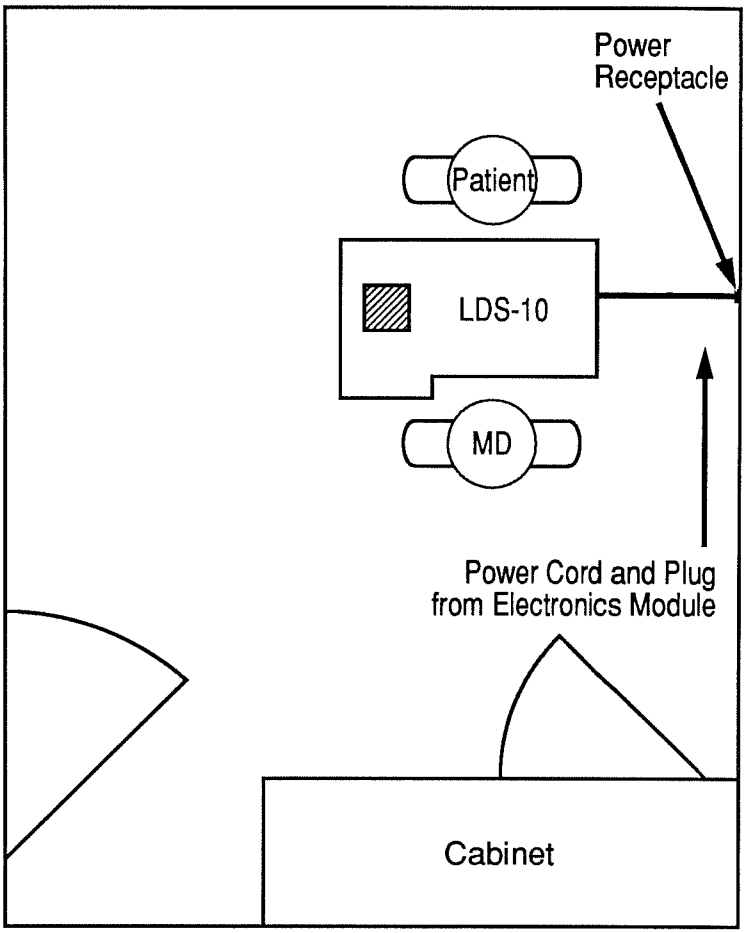
- Power requirements for the 7970 Nd:YAG and 7901 Nd:YAG lasers are 115/230 volts AC, 50/60 Hz, 15 ampere outlet with ground. Other AC voltages may be used with a simple change to the power supply.

Room Layout

The following "Typical Laser Treatment Room Layout" figure illustrates a common room layout for the 7901 and 7970 Nd:YAG laser systems.



Typical Laser Treatment Room Layout 7901



Typical Laser Treatment Room Layout 7970

Section 2

Safety

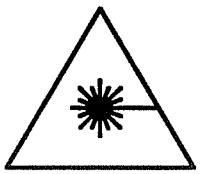
NOTE

Aiming Instructions, formerly located in Section 2.6.6 of this manual, have been moved to Section 3 "Directions For Use" item number 6 "Aiming Instructions".

Introduction

Nd:YAG lasers generate a highly concentrated, invisible beam of light which can be dangerous if improperly used. To protect operating personnel, this safety section should be read thoroughly after system installation and reviewed before each operation.

User Eye Protection



WARNING

Never look directly into the laser aperture (output lens) when power is applied.

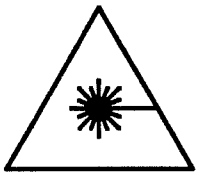
All personnel in the operating area must wear protective glasses in order to prevent accidental eye damage. (The exception to this is the surgeon or any observer looking only through the slit lamp oculars or observation tube. They are protected by a permanently installed internal safety filter.) Otherwise, the following appropriately tinted safety glasses are recommended:

- Type NDGA 7448-1, one piece, or type VL-NDGA, over-prescription design, from Glendale Optical, 130 Crossway Park Road, Woodbury, New York 11797, phone (516) 921-5800 or (800) 645-7530 outside New York.

- Type FR6-PL-KG3-GBS from Fred Reed Optical Co., 120 Bryn Mawr, S.E., P.O. Box 1336, Albuquerque, New Mexico 87103, phone (505) 265-3531.

Safety glasses may be ordered from Coherent or the suppliers indicated.

Tissue Protection



WARNING

Never place hand or other object in the pathway of the Nd:YAG laser beam.

Reflection Hazard

Metallic objects will reflect the Nd:YAG laser beam. Reflection hazards can exist several feet beyond the laser beam aperture.

Avoid directing the laser beam at unintended objects. Use low or non-reflecting instruments whenever possible.

Explosion Hazard

WARNING

Never operate the Nd:YAG laser in the presence of flammable anesthetics.

The focused Nd:YAG laser beam can ignite most non-metallic materials; explosive or flammable gases; and liquids, including some surgical preparation solutions.

FDA Compliance Safety Features

The 7970 and 7901 Nd:YAG lasers comply with 21 CFR, subchapter J, as administered by the National Center for Devices and Radiological Health of the United States Food and Drug Administration (FDA) and includes the following features.

Key Lock Switch

The laser can only be turned on with the proper key inserted in the Key Lock switch. The key cannot be removed in the on position and the laser will operate only with the key in place.

Laser Emission Indicator

The Key Lock switch turns on the system power. At this time, the front panel illuminates and the Laser Emission indicator lights. This warns the user that after a five second delay, laser radiation may be emitted from the system. A built-in delay prevents laser activity for five to seven seconds.

Remote Interlock Connector

The round Remote Interlock connector is mounted under the Nd:YAG laser Electronics Module for the purpose of connecting an external interlock should the user desire to have the unit disabled in case of certain external events (e.g., the opening of an operating room door). An electrical schematic of this connector is available from Coherent Service. Your Coherent Service Representative can assist in the hook-up of this interlock.

Protective Housing

The 7970 and 7901 Nd:YAG lasers have a protective housing which prevents unintended human access to laser radiation. This housing is to be opened only by a Coherent service engineer.

Safety Interlocks

No sections of the protective laser housing can be easily opened without tools. Safety interlocks are provided on the access panels to the power supply to protect the service technician from accidental electrical shock. The 7970 and 7901 Nd:YAG lasers do not contain any safety interlocks within the meaning of Section 1040 of 21CFR J.

Location of Controls

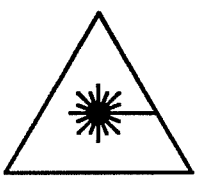
Controls are located on the Optics Module, Electronics Module, Table, and Control Panel. In each case, they are on a side of the instrument away from the output beam.

Viewing Optics

The viewing optics of the 7970 and 7901 Nd:YAG lasers consist of the slit lamp binoculars and the Magnification Changer. Safety filters in the system ensure that all laser radiation returned to the physician's eyes is below the Class I limit.

Manual Reset

If system operation during treatment is interrupted (for instance, by main electric power loss or by remote interlock activation, etc.) the 7970 or 7901 Nd:YAG lasers will automatically go into Standby. To resume treatment, press Laser Ready. Then, to deliver the treatment laser beam, depress the Footswitch or Firebutton.

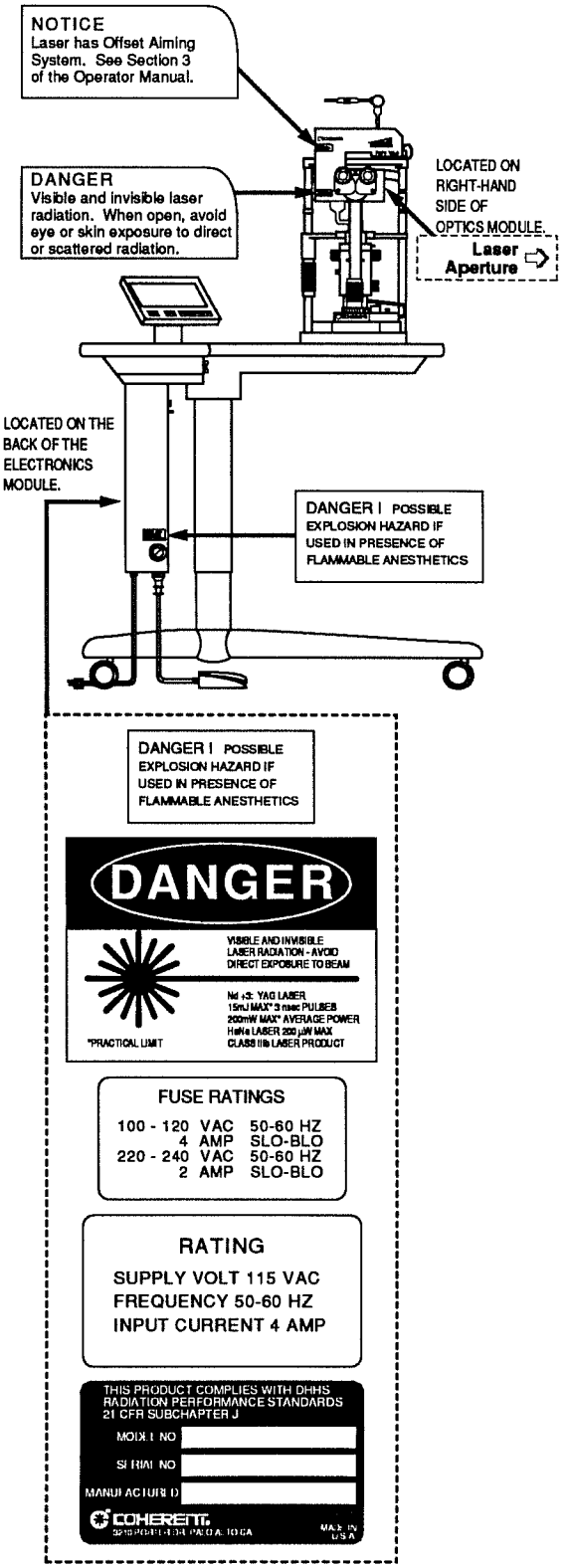


WARNING

To avoid accidental exposure to laser radiation, always move the patient out of the beam path before re-starting the system.

Location of FDA Compliance and Other System Labels

The following "Location of FDA Compliance and Other System Labels" figure illustrates the location of the FDA Compliance and other system labels.



Location of FDA Compliance and Other System Labels

Additional Safety Features

The 7970 Nd:YAG and 7901 Nd:YAG lasers are equipped with safety systems in addition to those required by the FDA which continuously monitor primary functions. Any malfunction or deviation from specified operating parameters will cause the laser to be disabled and a system fault to appear in the Display on the Control Panel.

Footswitch

An external Footswitch is provided; its usage may be optional on the 7970. The contacts control the safety shutter, making it impossible for the shutter to open unintentionally. The Footswitch is disabled except in the Ready mode.

Safety Shutters

The Optics Module is equipped with a spring loaded safety shutter. It is automatically closed except when the Nd:YAG status switch indicates the Ready condition and a laser fire switch command has been given. This shutter blocks the infrared beam but does not block the aiming beam. The aiming beam (HeNe laser) has a separate control switch.

Shutter Monitor

Shutter safety circuitry monitors shutter position to ensure proper operation. Should the shutter malfunction, the monitor circuits will automatically turn off the laser and a Service Error Code will appear on the Control Panel Display. To reset, turn the Power On/Off Key switch to Off, then, after waiting two seconds, to On.

Nd:YAG Safety Filter

Permanently installed infrared absorption glass for the 1064 nanometer wavelength is mounted in front of each view path of the slit lamp binoculars. These consist of three millimeter thick KG-3 Schott filter glass giving an attenuation of greater than 10^6 at the Nd:YAG wavelength for the physician's safety.

Energy Meter

The energy meter monitors actual laser output in millijoules as it exits from the laser system and indicates this value on the Control Panel Display.

Electronic Fault Detection Circuitry

If any of the electronic system monitors detect a fault condition, the operator can not fire the laser. A fault message will appear in the lower display on the Control Panel. The system can be reset only by turning the Power On/Off key switch to Off, then, after waiting two seconds, to On. A five second delay after turn on prevents immediate operation.

The following functions are typical of those monitored in a fail-safe design to prevent the laser from operating outside of specifications:

- Safety shutter closed
- Microprocessor function
- Safety shutter open
- Cable interconnections
- Nd:YAG laser failed to fire
- Selection wheels not in position

Repeated system fault messages indicate a system malfunction. Consult Coherent Service (see Section 7, "Sales and Service Offices").

Test Fire Circuitry

Laser test fire automatically takes place whenever the operator changes the power setting, the number of pulses per burst, or when the Laser Ready push button is depressed. The operator may also press the Test Fire push button if a test fire is desired. Each time a test fire occurs the laser will fire the number of pulses per burst selected. During test fire the safety shutter remains closed and no Nd:YAG energy is released from the instrument. Performing test fires will not increment the pulse count. The Energy Display readout shows the latest energy delivered during the test firing (including test fire).

Q-switch and Pulse Limiter

The 7970 and 7901 Nd:YAG lasers are Q-switched and will not operate in a long pulse or "thermal" mode. To prevent more than the desired number of laser pulses per flashlamp pulse, and to reduce the thermal load into the laser, the flashlamp energy will be shunted from the laser once the proper number of laser pulses have been produced.

Prism Head (7970 only)

The slit lamp illumination beam is directed at the patient's eye from below the Nd:YAG laser beam.

Focus Post or Focus Flag

The visual field and the HeNe laser aiming beam are adjusted to come into focus on the focusing flag (LDS-10, 7970) or focusing post (LDS-20, 7901) supplied with the slit lamp. Check the Diopter compensation on the binocular eyepieces before each use, making sure they are set correctly to ensure that the visual focus is precisely coincident with HeNe focus.

Magnification Changer

The Magnification Changer is located between the Optics Module and the binoculars. It provides two manually selectable magnifications. On some systems, there are five selectable magnifications. Because the Nd:YAG filter is placed before the Magnification Changer, the physician is always protected from reflected Nd:YAG laser light through the binocular eyepieces.

Electrical Leakage Protection

Electrical components and wires comply with U.L. standards. ❂

Section 3

Indications For Use

Indications For Use: Posterior Capsulotomy and Pupillary Membranectomy

CAUTION

Federal law restricts this device to sale to or on order of a physician.

NOTE

Information and clinical data in this section are the results of Coherent clinical studies on posterior capsulotomy. For more recent clinical information, consult the bibliograpy.

The Coherent System 7970 Nd:YAG and 7901 Nd:YAG ophthalmic lasers are indicated for (1) discission of the posterior capsule of the eye (posterior capsulotomy) and (2) discission of pupillary membranes (pupillary membranectomy) in aphakic and pseudophakic patients.

Patients may be of any age or sex.

The eye to be treated must have had its natural lens removed; it may have an intraocular lens (IOL) implanted. For posterior capsulotomy, the eye must have an aphakic capsular pupillary membrane (posterior capsule) which interferes with vision or with visualization of the retina.

Discission of pupillary membranes will be limited to treatment of any membrane located in the pupillary space (between the posterior capsule and the posterior aspect of the iris). The visual performance should be measurably hampered by this membrane(s). In general, this will mean that the visual acuity will be worse than 20/30. In patients with visual acuity of 20/30 or better, other visual disability (e.g., glare, poor reading vision) should be objectively determined to be related to the posterior capsule or pupillary membranes and the potential benefits determined to outweigh the potential risks described in "Warnings" below.

The eye to be treated should be medically stable.

Contraindications

A posterior capsulotomy or pupillary membranectomy should not be performed in patients with any of the following conditions:

(1) eyes with no potential visual functions;
(2) diffuse corneal haze or scarring;
(3) extreme haze of aqueous humor in the anterior chamber;
(4) uncontrolled glaucoma; and
(5) subjects with glass posterior chamber IOLs, except in those subjects whose medical condition precludes invasive surgery.

Warnings

1. Poor Candidates for Surgery
As with any surgical procedure, there are risks involved in an Nd:YAG posterior capsulotomy or pupillary membranectomy, including:

(1) significant transient elevation of intraocular pressure (IOP);
(2) persistent elevation of IOP;
(3) cystoid macular edema;
(4) rupture of the anterior hyaloid face and anterior displacement of the vitreous; and,
(5) retinal detachment.

The potential impact of use of high energy levels and a high number of laser pulses (at the upper limits of the available ranges) to disrupt some pupillary membranes must be considered. The anterior shift of the plane of optical breakdown from the focal point and elongation of the breakdown region that occurs as power increases becomes significant at high energy levels. These effects may result in increased risk of injury to the corneal endothelium, the iris, and, if present, an intraocular lens (IOL). Corneal, iris, and IOL status should be evaluated prior to, and monitored closely during and after, procedures in which high pulse energies are used. Additionally, the transient rise in intraocular pressure (IOP) that follows Nd:YAG laser posterior capsulotomy in many patients should also be monitored following pupillary membranectomy. The release of debris due to disruption of pupillary membranes should be recognized for potential impact on IOP.

Accordingly, the physician should make an objective assessment of the potential benefits of the capsulotomy or membranectomy in light of the risks.

Patients with any of the following conditions may not be suitable candidates for posterior capsulotomy or pupillary membranectomy because the procedure may not improve visual acuity or visualization of the posterior segment, or may pose a special risk to the patient's eyesight:

Active ocular disease, nystagmus, blepharospasm, slight or moderate haze of the aqueous humor, poor vision (20/40 or worse) and clear optical media including the capsule, good vision (20/30 or better) and no serious visual disability (e.g., glare, poor reading vision) related to the posterior capsule (several clinical studies of the Nd:YAG posterior capsulotomy have shown that, of patients with 20/40 or better vision preoperatively, 2% to 7% decreased postoperatively), and inability to cooperate in the procedure.

2. Elevations of Intraocular Pressure (IOP)
Significant rises in IOP occur following a posterior capsulotomy and pupillary membranectomy in a substantial number of treated patients. Patients should be carefully monitored during the postoperative period. Clinical data suggests that a pressure rise, if it will occur at all, is almost always well developed within 2 to 3 hours after the operation. In most normal eyes, the IOP rise peaks within 2 to 4 hours. If the patient was already on medication for ocular hypertension, however, the pressure may still be increasing 4 to 6 hours after surgery.

Patients with a preoperative IOP greater than 20mm Hg or preoperative treatment with glaucoma medications appear to be at greater risk, as do those with other evidence of deranged aqueous dynamics or poor outflow facility. Other risk factors for elevation of IOP are: use of high total amounts of energy during the procedure, absence of an IOL, and use of cycloplegic drugs.

The decision to intervene in the event of a rise of IOP must be based on the status of the individual patient. Most elevations resolve without intervention within 24 hours of Nd:YAG surgery. In a small proportion of cases, however, elevations of IOP persist, so a patient experiencing significant postoperative rises in IOP should be monitored until the condition is stabilized. Of the patients in the clinical studies who were not receiving IOP-lowering medications preoperatively, 2% to 3% were receiving these drug at six months postoperatively.

3. Damage to Intraocular Lens (IOL)
An IOL of any type may be damaged by Nd:YAG laser energy; damage may include pitting or cracks. About 25% of the IOLs were damaged during clinical studies for posterior capsulotomy. Posterior chamber IOLs are more likely to be hit. The risk of damage increases:

   (1) If the patient has a posterior chamber IOL;
   (2) If the posterior capsule lies close to the IOL;
   (3) As the level of total energy (total number of pulses) increases.

   When a posterior capsulotomy or pupillary membranectomy is performed on a patient with an IOL, the following actions are recommended:

   (1) Optimize the view of the posterior capsule or pupillary membrane by finding the combination of slit height and width that maximizes the faint, diffuse light reflex from the target tissue while minimizing the bright, specular light reflex from the polished IOL.

   (2) Use a contact lens (see below "Directions For Use" item number 2 "Use of a Contact Lens").

   (3) Place the HeNe aiming beam focus precisely on the target membrane. If the membrane does not open or is not severed, move the aiming spot to another location on the membrane.

(4) Avoid making successive firings through the same spot on the IOL. Each exposure reduces the PMMA (poly-methyl methacrylate) damage threshold for subsequent exposures.

(5) Use the lowest energy setting necessary to open or sever the membrane.

(6) If pitting of the IOL begins to occur, the physician should consider the potential for glare resulting from multiple pits and weigh this risk against the potential benefits of continuing the procedure. If the procedure is to continue, the physician should review the precautions discussed below in "Directions for Use".

(7) Extreme care should be used in assessing whether a subject with a glass intraocular lens (IOL) should undergo Nd:YAG laser treatment. Instances of cracked or broken glass IOLs have been reported. In some cases, explantation may be necessary. If Nd:YAG laser treatment is selected, it should be conducted at low energies, with extreme care.

(8) Avoid use of a burst mode.

4. Bleeding
Mild bleeding may occur if the target membrane is vascularized. Bleeding will generally stop spontaneously. If not, this condition may require treatment or interfere with (or be aggravated by) immediate continuation of the Nd:YAG procedure.

5. Rupture of the Anterior Hyaloid Face
A significant proportion of patients (about 25% in the clinical studies for posterior capsulotomy) will experience rupture of the anterior hyaloid face following Nd:YAG capsulotomy. Such patients are at risk of having forward movement of the vitreous resulting in corneal edema. A posterior chamber IOL appears to offer some protection against forward vitreal movement, provided that the posterior capsule opening is small.

6. Pupillary Block
In patients who have undergone an extracapsular cataract extraction without also having an iridectomy, there is a risk of pupillary block developing following an Nd:YAG posterior capsulotomy. The incidence appears small, but patients without a patent iridectomy should be advised that if pain or other symptoms of block develop after surgery, they should contact the treating physician immediately.

7. Retinal Damage
Retinal detachments, tears and holes, and cystoid macular edema (CME) have occurred after Nd:YAG posterior capsulotomies. The incidence of detachments and tears is very low (less than 1%) and CME rates up to 2% to 3% have been observed in clinical studies for posterior capsulotomy.

8. Patient Categories at Risk
The following categories of patients appear to face special risks when undergoing Nd:YAG posterior capsulotomy or pupillary membranectomy:

   (1) ECCE (extracapsulary cataract extraction) patients who do not have a patent iridectomy are at a small risk of aphakic or pseudophakic pupillary block.

   (2) Patients with preoperative IOP of greater than 20mm Hg, or with active preoperative treatment with glaucoma medications, or with other evidence of deranged aqueous dynamics or poor facility outflow, are at increased risk of elevation of intraocular pressure in the immediate postoperative period.

   (3) Aphakic patients (those without IOLs) are at slightly increased risk of elevation of intraocular pressure in the immediate postoperative period.

(4) Patients with an implanted intraocular lens are at increased risk of lens damage either if they have a posterior chamber IOL or if the posterior capsule lies close to the IOL. Posterior chamber IOLs close to the posterior capsule are at greatest risk of damage.

(5) Patients with vascularization of any target membrane are at increased risk of bleeding.

Precautions

1. Targeting
   Unlike other lasers commonly used in ophthalmology (i.e., argon, krypton, and dye lasers) which rely on thermal effects, the Nd:YAG laser is a cutting or disrupting instrument with capability of damaging any tissue or structure on which the beam is focused. Therefore, the Nd:YAG laser beam should only be focused on target tissues and caution should be used to avoid damage to all adjacent tissues and structures.

   Keep in mind that the focal point of the Nd:YAG working beam is factory-set slightly posterior to that of the HeNe aiming beam, providing an optimal offset for maximum photoacoustic effect when focused on the target.

2. Patient Movement
   Inadvertent or uncontrollable eye movement by the patient may result in hitting non-targeted tissues. If a patient cannot fixate with the untreated eye to ensure stabilization of the treated eye, use of a contact lens or retrobulbar anesthesia may be advisable.

3. Energy Used
   Minimal energy should be used to reduce risk of damage to non-target areas. Use of high levels of total energy, number of pulses, and multiple pulses-per-burst have been associated with an increased risk of IOL damage.

Adverse Effects and Complications

1. Sight Threatening Adverse Effects and Complications
   The following sight threatening adverse reactions and complications have been observed in patients who have undergone Nd:YAG posterior capsulotomy. These adverse reactions and complications may also occur following Nd:YAG pupillary membranectomy, but may not have been observed clinically.

   Transient or sustained elevated intraocular pressure; rupture of the anterior hyaloid face of the vitreous; anterior displacement of the vitreous; pupillary block; corneal edema; hyphema; iritis; neovascularization of the iris; vitritis; vitreous hemorrhage; vitreal-corneal touch; retinal hemorrhage; retinal detachment; retinal tears or holes; and cystoid macular edema.

2. Other Adverse Effects and Complications
   Other problems reported following Nd:YAG laser posterior capsulotomy and pupillary membranectomy are:

   Corneal injury (including damage to the endothelium, stroma or epithelium), anterior chamber injury (including loose cortex or capsular fragments, flare, cells, or debris), intraocular lens damage (including pits, fractures, or dislocations), iris damage, intraocular bleeding, vitreal chamber injury (including loose cortex or capsular fragments), and generalized endophthalmitis with vitreous involvement.

Directions For Use

1. Energy Settings
   As a general practice, the energy settings for treatment should be the minimum energy necessary to perform the treatment, particularly if the eye contains an IOL. The risk of damage to an IOL increases as the total amount of energy used, or the number of pulses fired, increases.

   A typical posterior capsulotomy or pupillary membranectomy with the 7970 or 7901 will begin with 0.5 millijoule (mJ), with energy increased as required until tissue breakdown is achieved. Energy settings rarely exceed 2.6 millijoules. A burst of one (1) is usually used when performing posterior capsulotomies and pupillary membranectomies. If results are not obtained at 2.6 millijoules and 1 pulse per burst, the procedure should be reevaluated before continuing. The need for increased energy may suggest improper focus, a media problem, or instrument difficulties, as well as tenacious membranes.

2. Use of a Contact Lens
   When performing a posterior capsulotomy or pupillary membranectomy, a contact lens may be useful for controlling eye movement and altering the energy density at the treatment site. The contact lens virtually eliminates the astigmatic distortion due to the cornea for both the HeNe aiming beam and the Nd:YAG treatment beam but also will introduce its own astigmatism, depending on the specific type of contact lens selected. The astigmatism generally is greater in the periphery of most of these lenses or if under conditions that the lens is tilted relative to the treatment of aiming beams. Since the astigmatism will change the energy density at the treatment site, the energy setting should be adjusted to the minimum energy and increased until there is a tissue response.

3. Treatment Approach
   Posterior Capsules: Two methods have been widely used in the surgical opening of the posterior capsule of the eye: the central approach and

the semi-circular approach. In clinical trials of the Nd:YAG posterior capsulotomy, the central approach was used in approximately 90% of the cases, and produced capsular openings equal in size to those obtained through the semi-circular approach. Moreover, the central approach required significantly less total energy (requiring less energy per pulse and fewer pulses) and less operative time.

The central approach is used when the desired result is to clear the optical pathway in the area of the visual axis. Mydriatics may or may not be instilled. This technique is accomplished by focusing the beam in the center of the capsule within the region of the visual axis. The commonly used shape is an "x" or a "+", with one of the rows laid across the stretch lines of the capsule. In the case of a less experienced clinician the first laser application should be made at the extremes of the "x" or the "+", with the last application in the middle. With the experienced clinician, the first pulse located centrally will more likely produce an adequate opening with minimum laser pulses. After accomplishing the central dehiscence of the capsule, subsequent applications can be applied along the distal ends of fractures within the capsule.

The semi-circular approach is a curvilinear approach, where the bottom remains intact and the membrane folds back, forming a large opening in the posterior capsule to facilitate a better view of the posterior segment and to improve visual acuity. Do not leave the capsule hinged above, because it may curl on itself into the visual axis. Mydriatics are instilled with this approach. Treatment is begun in the paracentral capsular zone, usually along stress lines in the capsule, in order to get greatest dehiscence from each application of the laser. Applications of the laser are subsequently applied in a curving pattern (like an inverted "U") in order to create a semi-circular opening in the capsule. Distance between laser applications is determined by the magnitude of the fracture of the capsule produced with each application.

Pupillary Membranes: Treatment of pupillary membranes is accomplished by focusing on the target membranes, which may extend from the corneal wound through the pupillary space, defined as between the posterior capsule and the posterior aspect of the iris.

4. Opening Size for Posterior Capsulotomy
   The ideal size opening for a posterior capsulotomy is not known. Generally, the opening should be large enough to permit the patient to see without glare, but not so large as to encourage vitreous movement forward. If the physician chooses to make an opening the size of the undilated pupil, but to dilate the pupil for treatment, a drawing is advisable indicating the size of the undilated pupil and the approximate center of the visual axis. A larger opening may be indicated to permit adequate visualization of the posterior segment.

5. Dilation
   An Nd:YAG laser posterior capsulotomy and pupillary membranectomy may be performed with or without dilation of the pupil. Dilations may improve the surgeon's depth perception and make landmarks more obvious.

6. Aiming Instructions
   In the 7970 and 7901, the focal point of the invisible Nd:YAG laser beam is set posterior to the focal point of the visible dual helium neon (HeNe) aiming beams, providing an optimal energy density for treating the desired tissue. The superposition of the twin HeNe aiming beams, where the two red spots become one, accurately defines the aiming point.

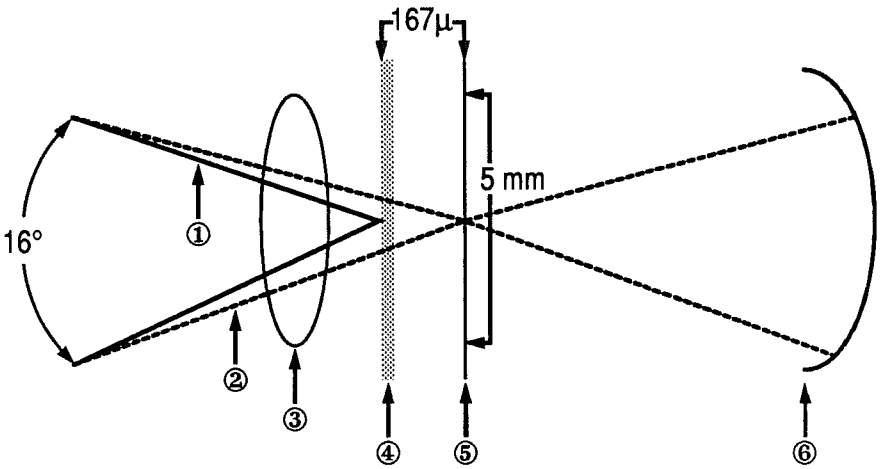
   Multiple reflections of light from the aiming beams and slit lamp illumination present difficulties in focusing. These effects can be decreased through a combination of factors including slight off-axial direction of the slit lamp, use of a contact lens, and selective positioning of the patient.

   When treating the patient with an intraocular lens (IOL), focus on the capsule until the twin HeNe aiming beams merge into a single spot. To mini-

mize risk to the IOL, start at minimum energy and increase the energy until the desired hole size is achieved in the capsule. Successive shots, however, should be positioned to avoid repeated firings through the same spot on the IOL. Each exposure reduces the PMMA damage threshold for subsequent exposures.

When performing a pupillary membranectomy, the HeNe aiming beams should be merged to a single point on the membrane near the pupil or over the iris within the pupillary space. To avoid damage to the corneal endothelium, do not focus on or within 5 mm of the posterior aspect of the cornea.

The Nd:YAG laser should not be focused on or near the iris when performing a posterior capsulotomy or pupillary membranectomy, because shock waves may produce bleeding. The bleeding will generally stop spontaneously but may require treatment or may interfere with (or be aggravated by) further immediate surgery.



① HeNe Aiming Beam
② Nd:YAG Treatment Beam
③ Intraocular Lens
④ Capsular Membrane
⑤ Nd:YAG Breakdown
⑥ Retina

Aiming/Treatment Beam Offset

7. Illumination
   Better depth perception for use in treatments may result when the slit lamp illumination is positioned slightly off-axis from the HeNe aiming beam.

8. Magnification Changer
   The 7970 and 7901 are both equipped with a magnification changer. Some systems are equipped with a two position changer, while more recent units have a five position unit. Once the topography of the eye has been defined with the lower magnification, the higher magnification may be useful for better visualization of the treatment site. Additionally, the higher magnification allows more accurate determination of the position where superposition of the aiming beams occurs.

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Indications For Use: Iridotomy

NOTE

Information and clinical data in this section are the results of Coherent clinical studies on iridotomy. For more recent clinical information, consult the bibliograpy.

The Coherent System 7970 Nd:YAG and 7901 Nd:YAG Ophthalmic Lasers are indicated for performing an iridotomy (hole in the iris).

The eye to be treated must be at risk of some form of acute, sub-acute, intermittent, or chronic pupillary block glaucoma. The eye may be phakic, pseudophakic, or aphakic. The blockage of the outflow of aqueous humor through the pupillary aperture should be either respon-

sible or potentially responsible for glaucomatous damage to the optic nerve because of levels of intraocular pressure that are known to cause such damage. The existence of pupillary block glaucoma should be objectively determined prior to treatment. The potential benefits should outweigh the potential risks of treatment described in "Warnings" and "Precautions" below and the potential benefits and risks of no or alternative treatment.

Patients may be of any age or sex.

Contraindications

An iridotomy should not be performed in patients with any of the following conditions:

(1) Eyes with opacities of the media such that the iris cannot be adequately visualized.
(2) Eyes without a pupillary block component to their glaucoma.
(3) Eyes with a glass intraocular lens.

Warnings

1. Risks
   As with any surgical procedure, there are risks that have been observed in Nd:YAG laser iridotomy, including:

   (a) Significant transient elevation of intraocular pressure (IOP) (see #3 below for details).

   (b) Damage to the lens (see #4 below for details).

   (c) Transient bleeding from the iridotomy margin, and hyphema (see #5 below for details).

   (d) Localized corneal damage (see #6 below for details).

   (e) Transient anterior chamber flare, cells, and debris.

   (f) Closure of the iridotomy with time (see #8 below for details).

   (g) Inability to control glaucoma adequately (despite a successful iridotomy), necessitating chronic medical therapy or further invasive intraocular surgery (see #9 below for details).

In addition, there are risks that have not been reported but are theoretically possible in Nd:YAG laser iridotomy, including:

(1) Persistent elevation of the IOP.
(2) Rupture of the anterior hyaloid face and anterior displacement of the vitreous in an aphakic eye.
(3) Damage to the retina or choroid.

Accordingly, the physician should make an objective assessment of the potential benefits of Nd:YAG laser iridotomy in light of these risks.

2. Poor Candidates for Surgery
Patients with any of the following conditions may not be suitable candidates for Nd:YAG laser iridotomy because of the risks of bleeding, inability to create an iridotomy, or iridotomy closure:

(1) slight or moderate haze of the cornea or aqueous humor;
(2) chronic uveitis;
(3) pupillary block associated with neovascular glaucoma or with any condition causing engorged iris blood vessels;
(4) tendency to bleed (e.g., as with hemophilia or receiving anticoagulant therapy);
(5) inability to cooperate in the procedure;
(6) Nystagmus; and
(7) Blepharospasm

3. Elevations of Intraocular Pressure (IOP)
Significant rises in the IOP occur following both argon laser and Nd:YAG laser iridotomy in a substantial proportion of treated eyes. The risks of IOP elevation do not appear to differ between Nd:YAG laser and argon laser treatment. Patients should therefore be carefully monitored during the postoperative period. Clinical data suggest that if a pressure rise will develop, it is almost always detectable within the first two to three postoperative hours. No risk factors are yet known to be positively associated with this IOP rise after iridotomy. However, eyes with acute pupillary block glaucoma tend not to have this problem.

The decision to use additional medical treatment in the event of a rise of IOP should be based on the status of the individual patient. Most elevations resolve without intervention within 24 hours of Nd:YAG laser surgery. The treating physician should take into consideration the pre-existing condition of the optic nerve and other ocular structures when deciding whether to treat the eyes with intraocular pressure lowering medication.

4. Damage to the Lens
Clinically visible evidence of lens damage has not been reported to date following Nd:YAG laser iridotomies in humans, but Nd:YAG laser-induced damage to the crystalline lens has been noted in animal studies and in human histologic studies. The risk of lens damage during Nd:YAG laser iridotomy will increase if:

(1) Laser focusing is inaccurate.
(2) Laser energy is applied through an already patent iridotomy.
(3) Laser energy is applied through the pupil directly to the lens.
(4) Burst modes greater than 3, and/or energy levels greater than 10 millijoules are used.
(5) There is apposition of the peripheral iris to the lens as might occur with extensive posterior synechiae.

To reduce the risk of lens damage when an iridotomy is performed, the following actions are recommended:

(1) Ensure good patient fixation.
(2) Use an appropriate contact lens (see below "Directions For Use" item number 2 "Use of a Contact Lens").
(3) Select an iris treatment site as far in the periphery as is practical (as with all iridotomies, the site should be located under the upper lid whenever possible).
(4) Focus the HeNe aiming beam upon the surface of the treatment site.
(5) Use the minimum number of pulses per burst.
(6) Use the lowest possible amount of energy per pulse.

(7) Avoid treatment through a site which is already totally or partially patent.

5. Bleeding
Mild, localized bleeding occurs in 20% to 50% of eyes undergoing Nd:YAG laser iridotomy. Mild hyphema is rare (less than 2%) and severe hyphema is very uncommon (less than one in 200). Unlike an argon laser, an Nd:YAG laser creates minimal heat at the treatment site and therefore does not cauterize vessels. Eyes with engorged iris blood vessels (active uveitic or neovascular angle closure glaucoma) are at an increased risk of bleeding. Patients who are otherwise at risk of bleeding (e.g., as with hemophilia or receiving anticoagulant therapy) are also at an increased risk of bleeding and hyphema.

In otherwise normal patients with pupillary block glaucoma, bleeding usually stops spontaneously and can be controlled by digital pressure upon the contact lens. All eyes should be observed with a biomicroscope for bleeding. If bleeding occurs, additional Nd:YAG laser treatment may aggravate it. Further, if bleeding does not stop spontaneously or after applying digital pressure, argon laser photocoagulation of the bleeding site may be necessary.

6. Corneal Damage
Localized corneal endothelial lesions have been produced above the iridotomy site in 10%-20% of eyes treated with Nd:YAG laser. These opacities may interfere with visualization of the iridotomy. In most eyes these opacities clear within a few days; occasionally there is a permanent non-progressive small diameter opacity. The changes do not interfere with visual function. Careful laser focusing and the lower energy settings may decrease the likelihood of this problem.

7. Retinal Damage
Although no retinal damage after Nd:YAG iridotomy has been noted to date, it is theoretically possible.

8. Closure of the Iridotomy with Time
Closure of iridotomy has been reported in a small percentage of cases weeks or months after Nd:YAG laser treatments; this closure occurs most frequently in eyes with chronic uveitis. The closure rate for Nd:YAG laser iridotomies is much lower than for argon laser iridotomies. In a randomized study reported in the literature in bilateral primary chronic angle-closure glaucoma, each patient received treatment in one eye with an Nd:YAG laser and with an argon laser in the other eye. Within the first postoperative month, 9 of 50 argon laser treated eyes experienced iridotomy closure, compared to none of the Nd:YAG laser treated eyes.

9. Failure to Control Glaucoma
Successful iridotomies are not necessarily accompanied by long-term control of glaucoma, for several possible reasons:

   (1) The eye may have developed peripheral anterior synechiae (PAS).
   (2) The angle may be open but the eye may have residual open angle glaucoma.
   (3) A combination of the above.

   Patients should be monitored for persistent glaucoma.

10. Categories of Patients at Special Risk
The following categories of patients face special risks when undergoing an Nd:YAG laser iridotomy:

   (1) Patients with chronic uveitis have an increased tendency towards both early and late iridotomy closure.

   (2) Patients with vascularization of the iris or engorgement of iris vessels are at increased risk of bleeding.

   (3) Patients with a bleeding tendency (e.g., because of hemophilia or use of anticoagulant medication) are at increased risk of bleeding.

Precautions

1. Targeting
   Unlike other lasers commonly used in ophthalmology (i.e., argon, krypton, and dye lasers) which rely on thermal effects, the Nd:YAG laser is a cutting or disrupting instrument with capability of damaging any tissue or structure on which the beam is focused. Therefore, the Nd:YAG laser should only be focused on target tissues and caution should be used to avoid exposure of all adjacent tissues and structures. Keep in mind that the focal point of the YAG working beam is slightly posterior to that of the HeNe aiming beam, providing an optimal offset for accurately focusing on the tissue to be cut.

2. Patient Movement
   Inadvertent or uncontrolled eye movement by the patient may result in hitting tissues adjacent to the target. If a patient cannot fixate with the untreated eye to assure stabilization of the treated eye, use of an anterior segment treatment contact lens and/or retrobulbar anesthesia may be advisable.

3. Energy Used
   Minimal effective energy and minimal pulses per burst should be used to reduce risk of damage to non-target areas. In animal studies, use of higher total energy, larger numbers of pulses, and more pulses per burst have been associated with an increased risk of damage to the lens. Lens damage has not been reported clinically in human eyes that have undergone Nd:YAG iridotomy.

Adverse Effects and Complications

1. Sight Threatening Adverse Effects and Complications
   The following sight-threatening adverse reactions and complications have been observed in patients who have undergone Nd:YAG iridotomy:

   (1) Transient elevated intraocular pressure
   (2) Hyphema

2. Other Adverse Effects and Complications
Other problems reported following Nd:YAG laser iridotomy are:

(1) Corneal injury (including damage to the endothelium, stroma or epithelium)
(2) Anterior chamber reaction (including flare, cells, and debris)

Directions For Use

1. Energy Settings
As a general practice, the energy settings for treatment should be at the minimum pulse energy and pulses per burst necessary to perform the treatment. The risk of ocular damage may increase as the total amount of energy used, or the number of pulses fired, increases. Animal studies have shown that the chance of crystalline lens damage increases with the use of greater than 10 millijoules (mJ) per pulse or greater than three pulses per burst. The treating physician should also be aware that likelihood of completing an iridotomy with one pulse is higher with the use of 10 mJ at one pulse per burst as the initial energy setting; however, there is also an increased risk of bleeding from the iridotomy margin with this higher energy setting. The benefits of easier and quicker iridotomy should be weighed against the increased risk of iris bleeding when choosing higher energy settings.

A typical Nd:YAG laser iridotomy will begin with 5 to 7 mJ at one pulse per burst, with energy increased in 1 to 2 mJ increments, or the burst mode increased to 2 or 3 pulses per burst, until the anterior lens capsule is visible through the iris opening. In thicker, dark brown irides without crypts, it may be advantageous to begin with 10 mJ in a single pulse. Iridotomy formation can often be accomplished with single pulses (approximately 45% - 50% of the time); it is occasionally beneficial to use 2 or 3 pulses per burst. Energy settings above 10 mJ have not yet been systematically studied. If results are not obtained at 10 mJ per pulse and two or three pulses per burst, the physician should reconsider the procedure before continuing. The lack of successful iris perforation

despite use of these treatment parameters may suggest improper focus, a media problem, instrument difficulties, or a tenacious iris.

2. Use of a Contact Lens
   Use of an anterior segment treatment contact lens is suggested when performing an iridotomy. The lens increases the laser beam convergence (thus minimizing the risk to non-target sites such as the cornea and lens), and increases the energy density at the treatment site. It also provides magnification, maintains eyelid separation, and reduces ocular movement. Topical anesthesia should be applied to the operative eye prior to the application of most contact lens. Contact your Coherent representative for specific contact lens recommendations.

3. Treatment Approach
   Pilocarpine Hydrochloride (1% to 4%) should be applied to the eye several hours prior to the treatment in phakic (and most aphakic and pseudophakic) eyes. This pre-treatment produces miosis and puts the iris on stretch, thereby facilitating iris perforation by the laser energy. After miosis is achieved and before laser treatment, the eye should be reexamined at the slit lamp to identify a treatment site.

   The sight selected for treatment should have as many of the following desirable characteristics as possible:

   (1) mid to far iris periphery;
   (2) central to the arcus senilis;
   (3) not at the 12 o'clock position;
   (4) superiorly between 9 and 3 o'clock;
   (5) nasally to avoid inadvertent macular damage;
   (6) in an area of an iris crypt, if one exists and is usable; and
   (7) away from an intraocular lens (IOL, optics, and haptics), if possible.

   The helium neon (HeNe) aiming beam should be focused on the treatment site.

Good patient fixation should be obtained.

After the initial laser pulse, the iridotomy site should be observed. If the anterior lens capsule can be clearly seen beneath it, no further laser therapy should be given.

If the iridotomy is not patent after the first pulse, and there is good patient fixation, the physician can treat the same spot with either increased Nd:YAG energy or more pulses per burst or both. If, however, there is poor fixation, it may be unwise to increase the pulses per burst, and only the energy level per pulse should be increased, if needed.

The eye should be observed at the slit lamp, with contact lens in place for 1 to 3 minutes, to ensure that no iris bleeding has occurred. If bleeding occurs, pressure can be applied to the contact lens to tamponade the bleeding.

After removal of the contact lens, treatment with topical corticosteroids may decrease the anterior chamber reaction. Patients should be reevaluated within two to three hours after surgery to identify marked elevation of intraocular pressure.

4. Opening Size
Visualization of the anterior capsule of the lens (in a phakic patient) or the anterior hyaloid face (in a pseudophakic or aphakic patient) is the desired end point. The ideal size for an iridotomy is not known. In eyes without pre-existing uveitis, it is unusual for an iridotomy created by a Q-switched Nd:YAG laser treatment to close once it is patent. Therefore, it is not necessary to enlarge a patent iridotomy created in this fashion.

5. Aiming Instructions
   In the Coherent 7970 Nd:YAG and 7901 Nd:YAG Ophthalmic Lasers, the focal point of the invisible Nd:YAG laser beam is set posterior to the focal point of the visible dual helium neon (HeNe) aiming beams, providing an optimal offset for accurately focussing on the tissue to be cut. The superposition of the twin HeNe aiming beams, where the two red spots become one, accurately defines the aiming point.

   Multiple reflections of light from the aiming beams and slit lamp illumination can make accurate focusing difficult. Use of a contact lens, slight off-axial direction of the slit lamp illuminator, and selective positioning of the patient often decreases this problem. The Nd:YAG laser should not be focused on or near iris blood vessels, because the shock wave may produce bleeding.

6. Illumination
   Better depth perception for use in treatment results when the slit lamp illumination is positioned slightly off-axis to the HeNe aiming beam.

7. Summary
   (1) A typical Nd:YAG laser iridotomy will begin with 5 to 7 mJ at one pulse per burst, with energy increased in 1 to 2 mJ increments, or the burst mode increased to 2 or 3 pulses per burst as required, until the anterior lens capsule is visible beneath the iris opening.

   (2) If results are not obtained at 10 mJ per pulse and two or three pulses per burst, the physician should reconsider the procedure before continuing.

   (3) Use of an anterior segment treatment contact lens is suggested when performing an iridotomy. Contact your Coherent representative for specific contact lens recommendations.

   (4) Pilocarpine hydrochloride (1% to 4%) should be applied to the eye several hours prior to the treatment in phakic (and most aphakic and pseudophakic) eyes.

(5) The site selected for treatment should have as many of the following desirable characteristics as possible:

- mid to far iris periphery;
- central to the arcus senilis;
- not at the 12 o'clock position;
- superiorly between 9 and 3 o'clock;
- nasally to avoid inadvertent macular damage;
- in an area of an iris crypt, if one exists and is usable; and
- away from an intraocular lens (IOL, optics, and haptics), if possible.

(6) The helium neon (HeNe) aiming beam should be focused on the anterior surface of the treatment site.

(7) Good patient fixation should be obtained.

(8) If the anterior lens capsule can be clearly seen beneath the treated iris, no further laser therapy should be given.

(9) Patients should be reevaluated within two to three hours after surgery to identify marked elevation of intraocular pressure.

(10) Visualization of the anterior capsule of the lens (in a phakic patient) or the anterior hyaloid face (in a pseudophakic or an aphakic patient) is the desired end point.

(11) To avoid induced beam astigmatism, the laser pulse should enter the eye no more than 30 degrees from the visual axis.

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Section 4

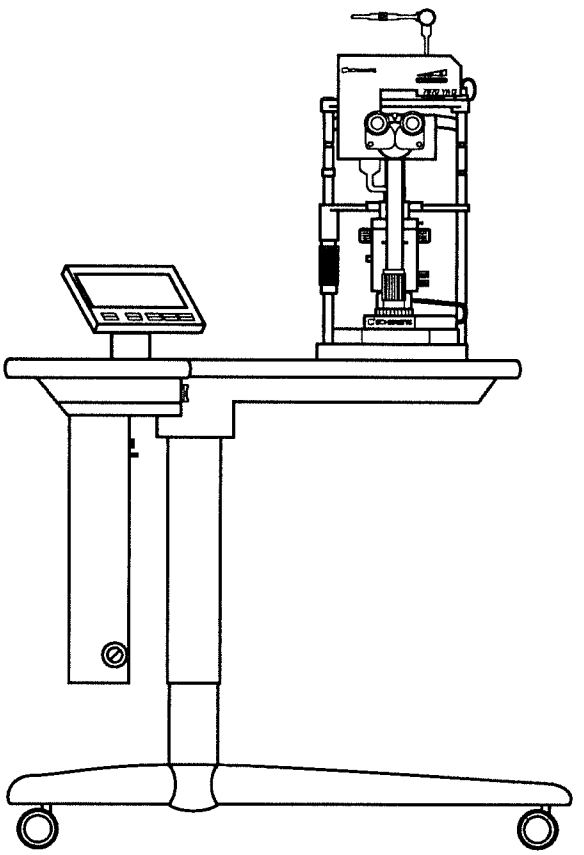
Instrument Description

General Description

The Coherent 7970 Nd:YAG and 7901 Nd:YAG lasers are instruments that produce a beam of infrared light (1064 nanometers wavelength). Unlike ophthalmic surgical lasers that use heat to burn tissue, the Nd:YAG laser concentrates an amount of energy at an extremely small focal point sufficient to create a plasma and disrupt tissue.

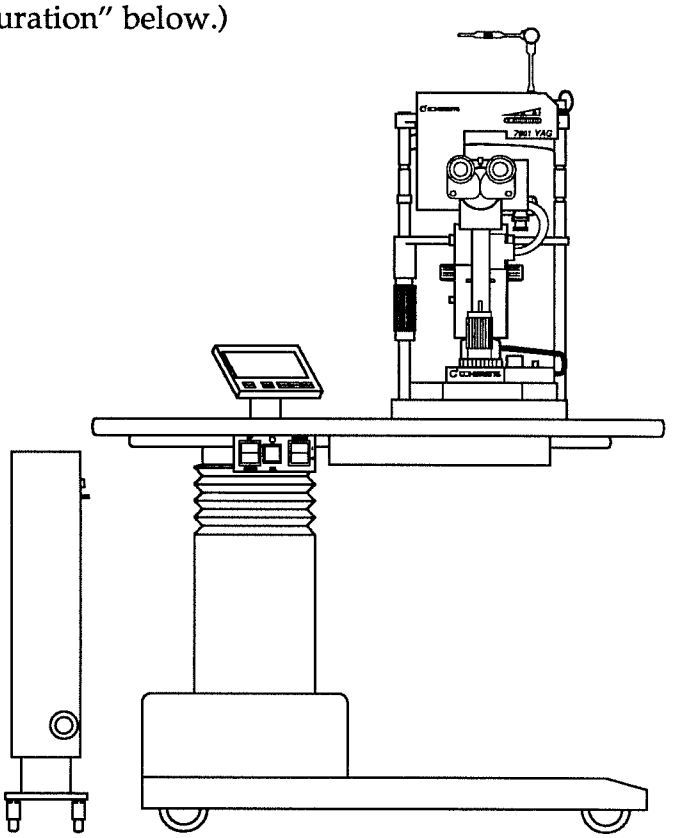
The 7970 and the 7901 are compact, easily moved, and self-contained units. The primary design criteria were operational safety and reliability. The 7970 and the 7901 are identical in operation; however, their system configuration is somewhat different (the 7970 is mounted to an LDS-10 with power table while the 7901 is mounted to an LDS-20 with power table).

7970 Nd:YAG System Configuration. The 7970 Nd:YAG is comprised of a Coherent LDS-10 Delivery System including a wheel chair-accessible power lift table, an Optics Module with laser source, a Control Panel and an Electronics Module. (See figure entitled "System 7970 Configuration" below.)



System 7970 Configuration

7901 Nd:YAG System Configuration. The 7901 Nd:YAG is comprised of an Optics Module with laser source, a Control Panel, and a free-standing Electronics Module which provides the power supply and logic to the laser source. It is compatible only with a Coherent LDS-20 Delivery System. (See figure entitled "System 7901 Configuration" below.)



System 7901 Configuration
(Compatible only with an LDS-20 Delivery System)

The components common to both lasers (and their configurations) are:

- The Optics Module, which is mounted on the slit lamp, contains the Q-switched, convection-cooled Nd:YAG laser, helium neon (HeNe) laser aiming beam, safety filters, shutters and associated optics.

- The Control Panel houses all system controls and indicators.

- The Electronics Module (located under the lift table with a 7970, or free-standing with a 7901) is microprocessor controlled and contains the power supply and transformer.

Each component will be discussed more thoroughly in the following sections.

Additionally, the 7901 is a component of the following combination laser systems:

7931 Argon/Nd:YAG System. The 7901 Nd:YAG is a component of the 7931 Argon/Nd:YAG System, along with the LDS-20 Delivery System and 930 Argon laser.

7921 Photocoagulator/Nd:YAG System. The 7901 Nd:YAG is a component of the 7921 Photocoagulator/ Nd:YAG System, along with the LDS-20 Delivery System and any of the Coherent photocoagulators (900, 910, 920 Argon, 920 Argon/Krypton, 920 Argon/Dye, and 930).

Slit Lamp and Optics Module

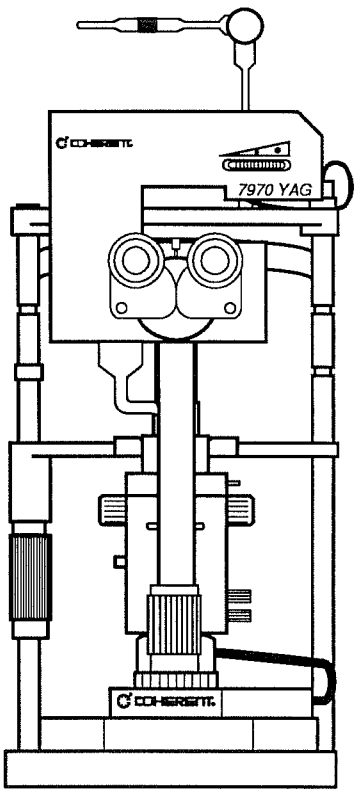
NOTE

For a detailed description of controls and indicators discussed in this section, see "Optics Module Controls and Indicators" later in this section.

A slit lamp is modified by the addition of the Optics Module (see figures entitled "Slit Lamps and Optics Modules") containing the Nd:YAG laser, Helium Neon (HeNe) aiming beam, Nd:YAG attenuation, and multiple power visual system. To guard the physician from exposure to laser radiation, the 7970 and 7901 include a permanent protective Nd:YAG laser safety filter for the binocular view path. The Nd:YAG filter allows visibility through the optics but blocks infrared Nd:YAG light.

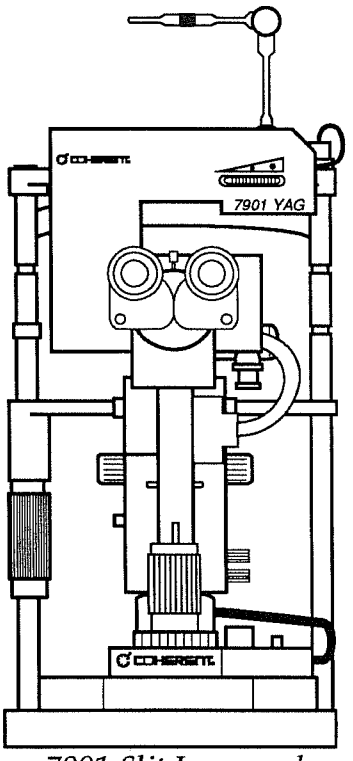
The Optics Module replaces the Magnification Changer of the slit lamp. The Magnification Changer has been moved behind the Optics Module, which contains the Nd:YAG laser and HeNe aiming beam laser. The beams of the two lasers are coaxial and the focal point of the Nd:YAG is set posterior to that of the HeNe aiming beam; the aiming system is parfocal in air with the microscope. The Optics Module contains the optical delivery system with the safety shutter and monitoring circuit. The optical system combines the HeNe beam with the Nd:YAG laser beam. When the Footswitch is depressed, the shutter opens and allows the Nd:YAG laser beam to follow the optical path to the target tissue for treatment.

In the Nd:YAG beam path is a manually actuated Nd:YAG power attenuator which optically attenuates the Nd:YAG output beam. It is controlled by the Energy Control attenuator on the Optics Module and is continuously variable for treatment between the maximum and minimum energy.



7970 Slit Lamp and Optics Module

The aiming beam system consists of the helium neon (HeNe) attenuator and a focus lens. The aiming beam focus adjustment, located within the Optics Module, is factory set. The aiming beam is combined with the Nd:YAG beam optics via a mirror. Because the Nd:YAG and HeNe beams are combined at the start of the optical path, misalignment between the Nd:YAG and HeNe is unlikely unless the device is significantly jarred or vibrated. The HeNe Aiming Beam attenuator provides three settings of aiming beam intensity for convenient viewing under different illuminations. Note that illumination may be rotated off-axis from the binocular viewing path to minimize reflections from contact lenses. Periodic checking of the Nd:YAG/ HeNe alignment is advised. It is a simple procedure performed by the physician (see Section 6 "Optical Alignment"). Actual alignment of the laser must be performed by a Coherent Service Engineer.



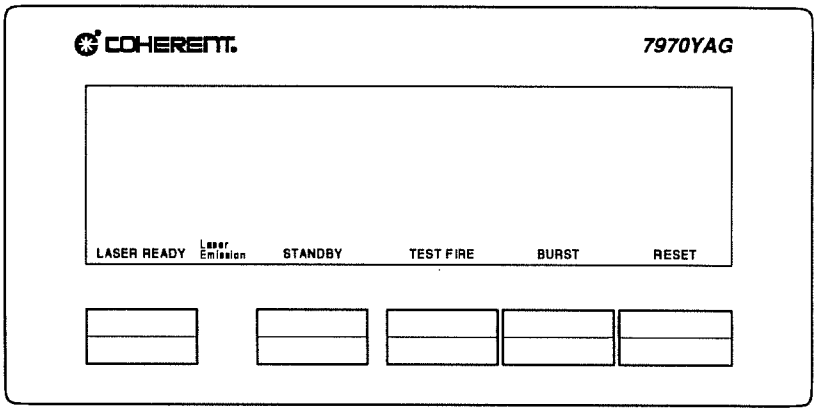
7901 Slit Lamp and Optics Module

Control Panel

NOTE

For a description of controls and indicators discussed in this section, see "Control Panel Controls and Indicators" later in this section.

The 7970 Control Panel is mounted in a fixed position on the left side of the slit lamp table. The 7901 Control Panel is movable and may be placed on either side of the table. Controls normally used during laser surgery are placed on the Control Panel. Status, energy and fault messages are presented on a fluorescent display consisting of two twenty-character rows. Switch labels are back lit for easy identification (see figure entitled "Control Panel" below).



Control Panel

Electronics Module

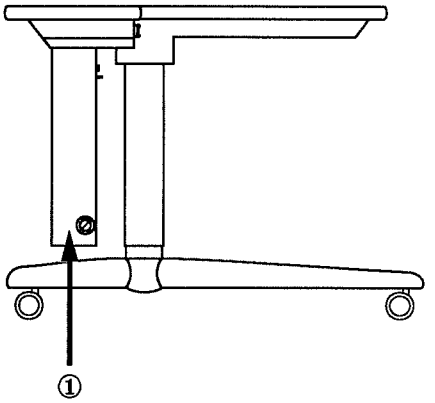
NOTE

For a description of controls and indicators discussed in this section, see "Electronics Module Controls and Indicators" and "Table Controls and Indicators" later in this section.

The microprocessor controlled Electronics Module (located under the motorized table top on the 7970 or free-standing with the 7901) contains the power supply, the table lift mechanism, and the footswitch cable (see figure entitled "Electronics Modules" below).

The System Power On/Off Key switch on the Electronics Module ensures that the instrument is used only by authorized physicians. The key must be used to turn on the 7970 or 7901. The key is removable only in the Off position, and the laser is not operable with the key removed.

The Electronics Module cover is equipped with an interlock to prevent system operation when the cover is removed. Only a Coherent Service Engineer should remove the Electronics Module cover; opening or removal of the cover by anyone other than a Coherent representative will void any existing warranty on the product.

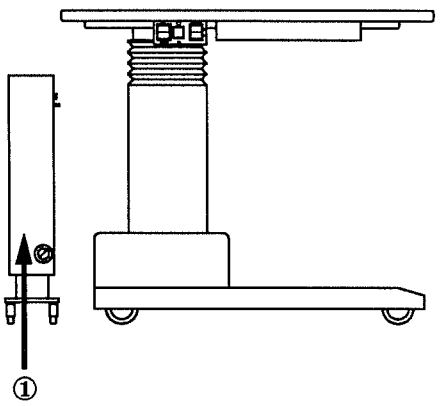


① Electronics Module

7970 Electronics Module

The Electronics Module provides the power to run the Nd:YAG and HeNe lasers. It provides power for all the control logic built into the Control Panel. The power supply is completely isolated from line voltage by an isolation transformer. It provides maximum ground protection and minimum leakage. Power dissipating components are cooled by conduction.

The table top has a motorized drive to elevate or lower the table and slit lamp assembly for convenience.

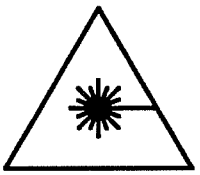


① Electronics Module

7901 Electronics Module

Depressing the Footswitch or Firebutton (7970 only) enables the operator to fire the laser.

Controls and Indicators



WARNING

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

Control Panel Controls and Indicators

The figure entitled "Control Panel Controls and Indicators" depicts the following controls and indicators.

Laser Ready Push Button

The Laser Ready push button activates the Nd:YAG laser, enables firing the laser. Depressing the selected actuator (Footswitch or Firebutton) will fire the Nd:YAG laser and the Nd:YAG laser beam will be delivered to the target site. "READY" will appear in the lower display of the Control Panel when the push button is pressed. The aiming beam will automatically come on when the Laser Ready push button is pressed.

Laser Emission Indicator

The Laser Emission status indicator is illuminated when the System Power On/Off Key switch is turned to the On position, informing the operator of the availability of 1064 nanometer laser radiation. There is a separate Aiming Beam Emission indicator (see following paragraph).

Standby Push Button

The Standby push button deactivates the Nd:YAG laser, disables firing, and ensures that Nd:YAG laser radiation will not be emitted from the system. "STANDBY" will appear in the lower display of the Control Panel when the push button is pressed. The HeNe aiming beam can be switched on or off by pressing the Standby push button. There is a five second delay between the time the button is pressed and the time the aiming beam laser comes on. The aiming beam is on when the laser is in the Ready mode. When the aiming beam is On the Aiming Beam Emission indicator, an asterisk (*), appears on the Control Panel.

Test Fire Push Button

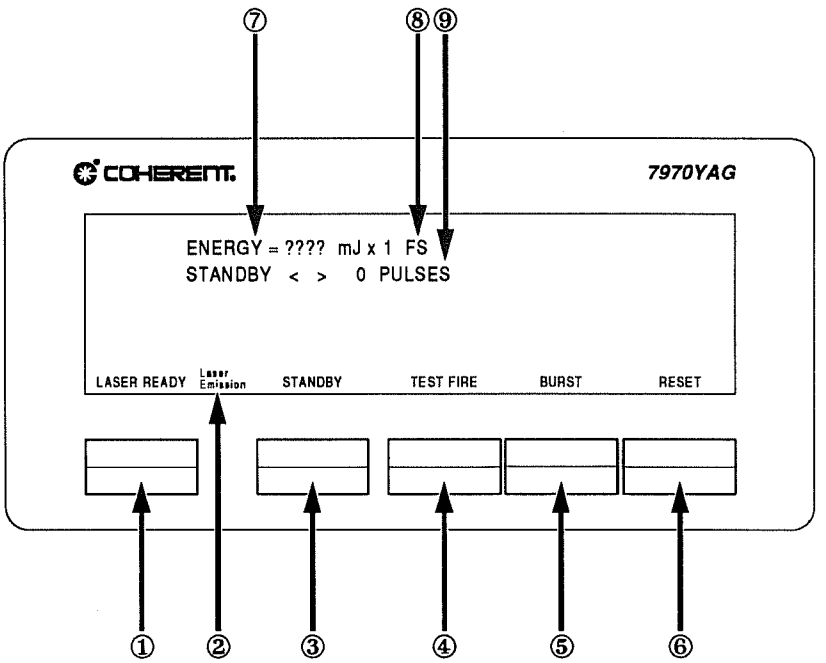
Depressing the Test Fire push button fires the Nd:YAG laser internally, one burst per activation. The shutter remains closed when the system is test fired, even when it is in the Ready mode so that no Nd:YAG radiation is released from the instrument. Test firing the laser by depressing the Test Fire button will not increase the pulse count or the total energy displays.

Burst Push Button

The Burst push button selects the number of pulses in a burst. The default (turn-on) setting is one pulse per burst. Depressing the Burst push button increases the number of pulses per burst in single increments. Depressing the Burst push button at the three (3) setting will return the number to one. A test fire will automatically occur if the Burst push button is depressed. "X1", "X2", or "X3" will appear on the upper display of the Control Panel, indicating a pulse per burst selection of one, two, or three respectively.

Reset Push Button

Pressing the Reset push button resets (to zero) the total amount of energy delivered and the total number of pulses delivered.



① Laser Ready Push Button
② Laser Emission Indicator
③ Standby Push Button
④ Test Fire Push Button
⑤ Burst Push Button
⑥ Reset Push Button
⑦ Upper Display Row
⑧ Actuator Indicator
⑨ Lower Display Row

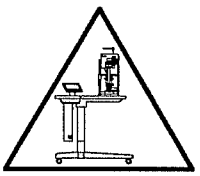
Control Panel Controls and Indicators

Energy Display

The Energy display, "ENERGY ????", automatically appears in the upper display on the Control Panel after turn on. During Standby, Test Fire, or Ready mode, it displays the energy of the pulse fired, or average of the pulses, to the nearest 0.1 millijoule.

System Fault and System Status Display

The lower display column on the Control Panel will show fault and status messages. A fault message will appear if the fail-safe self-monitoring circuits detect a system malfunction. To reset, turn the System Power On/Off key switch counterclockwise to the Off position, wait 2 seconds, then turn clockwise to the On position again.



NOTE

If repeated system fault messages occur after reset, call Coherent Service (see Section 7, "Sales and Service Offices").

Interlock Display

See Section 6 "Troubleshooting Guide."

Service Display

See Section 6 "Troubleshooting Guide."

Footswitch Out Display

See Section 6 "Troubleshooting Guide."

Fire Button Out Display

See Section 6 "Troubleshooting Guide."

Beam Blocked Message

See Section 6 "Troubleshooting Guide."

YAG Disabled Message

When the YAG Disabled message is displayed, the remote interlock circuit has disabled firing the laser. In the 7931 Nd:YAG/Argon or 7921 Argon/Nd:YAG Combination System, this is usually a result of not selecting the Nd:YAG laser (see Section 6 "Troubleshooting Guide").

TE Display

TE indicates the "total energy" delivered to the target tissue. This figure is arrived at by adding together the energy of all pulses.

Pulses Display

The "PULSES" display indicates the total number of pulses delivered to the target tissue.

Test Fire Display

The Control Panel will momentarily display the words "TEST FIRE" each time the system performs a test fire.

Aiming Beam Display

The aiming beam is on when the Aiming Beam Emission indicator, an asterisk (*), appears on the Control Panel.

X1, X2, X3 Display

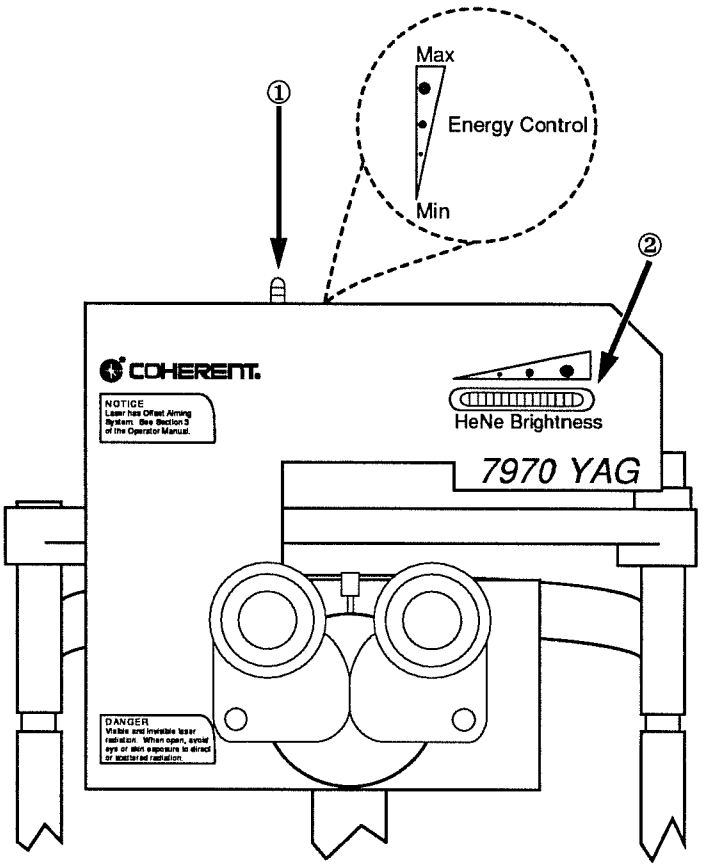
The "X1," "X2," or "X3" display indicates the number of pulses per Footswitch or Fire button activation that will be delivered to the patient.

Optics Module Controls and Indicators

The figure below entitled "Optics Module Controls and Indicators"depicts the following controls and indicators.

Energy Control Attenuator

The Energy Control attenuator is located on the Optics Module to adjust the energy attenuator setting. Each time the energy setting is changed, a bar graph representation of the relative energy that could be delivered will be shown on the Control Panel display. When the Energy Control attenuator stops for more than 1.5 seconds at a detent, the system automatically performs a test fire and the energy setting appears next to mJ (millijoules) on the Control Panel display. The attenuator is continuously variable from maximum to minimum power.

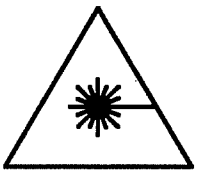


① Energy Control Attenuator
② Aiming Beam Attenuator

Optics Module Controls and Indicators

Aiming Beam Attenuator

An attenuator on the Optics Module is used to adjust the HeNe aiming beam intensity. Three intensities are selectable by rotating the adjustment wheel between detents. If the attenuator wheel is not left in a detent, the Control Panel display will show "HeNe BRIGHTNESS." The laser will fire only when the aiming attenuator wheel is in a detented position and the aiming beams are visible.



WARNING

The maximum safe power that can be visualized indefinitely by the retina is 0.39 microwatts (Class I). The HeNe laser that produces the aiming beam is a Class II laser. Direct patient visualization of Class II laser radiation has not been shown to be safe. To protect the patient from possible retinal damage, use the lowest practical aiming beam intensity during treatment.

The power levels provided by the aiming beam intensity control and their corresponding safe exposure limits are given below:

Beam Attenuation	Aiming Beam Power	Class I Exposure Duration Limit
●	.004 milliwatts (4 microwatts)	975 seconds
●	.012 milliwatts (12 microwatts)	325 seconds
●	.05 milliwatts (50 microwatts)	78 seconds

Electronics Module Controls and Indicators

The figures entitled "Electronics Module Controls and Indicators" depict the following controls and indicators.

Remote Interlock Connector

The round Remote Interlock connector is located on the bottom of the Electronics Module. Hook-up of an external interlock to the remote connector allows the user to disable the 7970 or 7901 when certain conditions occur, such as the opening of an operating room door. Any reliable switch may be used across the remote connector. The 7970 and 7901 will operate only when the switch is closed.

Footswitch

The Footswitch is an external foot pedal switch. When Footswitch is selected and the instrument is in the Ready mode, depressing the Footswitch delivers the Nd:YAG laser beam to the target.

System Power On/Off Key Switch

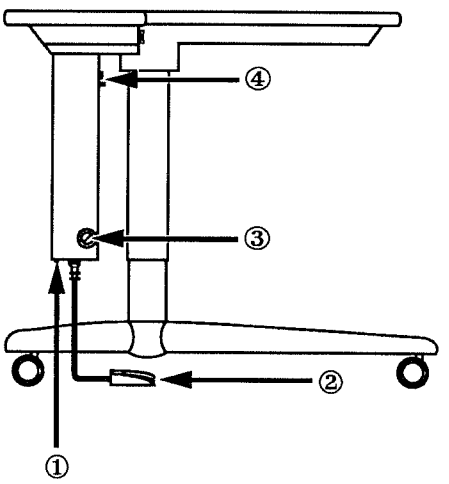
The System Power On/Off Key switch controls all power to functions of the 7970 and 7901.

Ready Indicator Adjustment

The Ready Indicator knob controls the volume of the ready indicator's audible tone. The tone will go on momentarily when the Nd:YAG laser is ready to fire

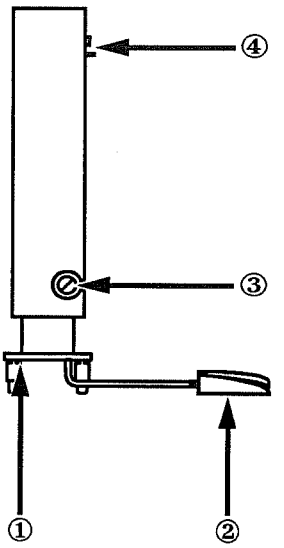
Ready Indicator Connector

The Ready Indicator connector is provided for an external earphone output of the ready indicator tone.



① Remote Interlock Connector
② Footswitch
③ System Power On/Off Key Switch
④ Ready Indicator Adjustment and Connector

7970 Electronics Module Controls and Indicators



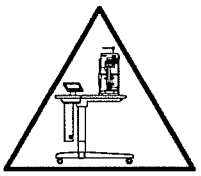
① Remote Interlock Connector
② Footswitch
③ System Power On/Off Key Switch
④ Ready Indicator Adjustment and Connector

7901 Electronics Module Controls and Indicators

Table Controls and Indicators

The figures below entitled "Table Controls and Indicators" depict the following controls and indicators.

7970 Table Height Adjustment Switch



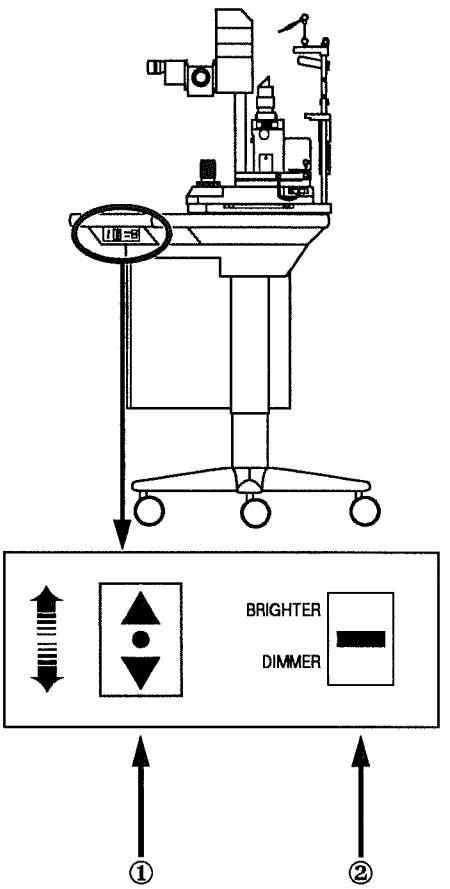
CAUTION

The 7970 Nd:YAG table has been designed to give the physician maximum up/down adjustment capability to provide the greatest possible patient-positioning comfort. Therefore, when lowering the table be aware of the height of the patient's knees and lower the table slowly. Be sure patient's hands are placed on the table.

The Table Height Adjustment switch is a rocker switch. It is used for raising and lowering the table with laser/slit lamp assembly for the convenience of the patient and surgeon. Center position is off.

7970 Slit Lamp Illumination Switch

The 7970 Slit Lamp Illumination paddle switch controls the illumination brightness of the Coherent LDS-10 Slit Lamp. Depressing and holding the switch up or down will increase or decrease (respectively) the illumination brightness. A momentary motion in either direction will turn the illumination on or off.



① Table Height Adjustment Switch
② Slit Lamp Illumination Switch

7970 Table Controls and Indicators

7901 Table Height Adjustment Switch

The 7901 Table Height Adjustment switch is used for raising and lowering the table with laser/slit lamp assembly for the convenience of the patient and surgeon. Center position is off.

7901 Fixation Light On/Off Push Button

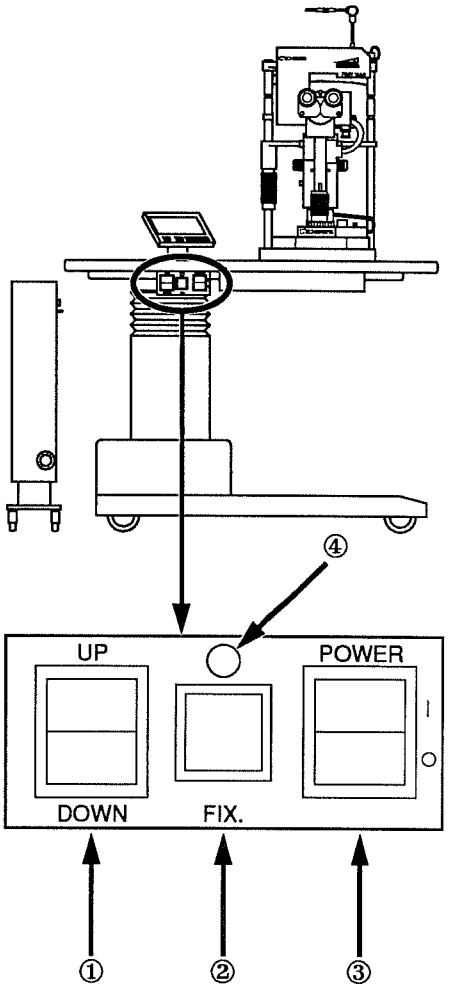
The 7901 Fixation Light On/Off push button turns the fixation lamp on the 7901 on and off.

7901 Table Power Switch

The 7901 Table Power switch is a two position rocker switch. Pressing the upper portion turns the table power on (if the System Power On/Off Key switch is in the On position) and pressing the lower portion turns the power off.

7901 Power On Indicator Light

The green 7901 Power On indicator light illuminates when the 7901 system power is turned on.



① Table Height Adjustment Switch
② Fixation Light Push Button
③ Table Power Switch
④ Power On Indicator Light

7901 Table Controls and Indicators

Coherent LDS-10 Slit Lamp Controls and Indicators

The LDS-10 is used with 7970 Nd:YAG. See figures entitled "LDS-10 Slit Lamp Controls and Indicators View A" and "LDS-10 Slit Lamp Controls and Indicators View B."

Firebutton

The Firebutton is a push button located on the slit lamp joystick (not available on the 7901). When Firebutton is selected (or when the Footswitch has been manually disconnected from the system) and the instrument is in the Ready mode, depressing the Firebutton delivers the Nd:YAG laser beam to the target.

Joystick

The Joystick is a vertical lever rising from the base of the slit lamp on the physician's side of the table top which allows the entire laser head to be moved in any horizontal direction.

- Gross Movements. When large movements are required, i.e., moving from one eye to the other, the joystick should be used as a handle to slide the whole unit over.
- Fine Movements. When fine, controlled movements are required, i.e., focusing the instrument to the treatment site, the joystick should be merely tilted.

Joystick Elevation Ring

When up or down movements are required, turn the Joystick Elevation Ring.

Joystick Lock

The Joystick Lock is a ring located at the base of the Joystick. To lock the Joystick in position turn clockwise; to unlock turn counterclockwise.

Light Bulb Housing Door

The Light Bulb Housing door is used to access the slit lamp bulb when the light needs to be changed.

Slit Prism Locks

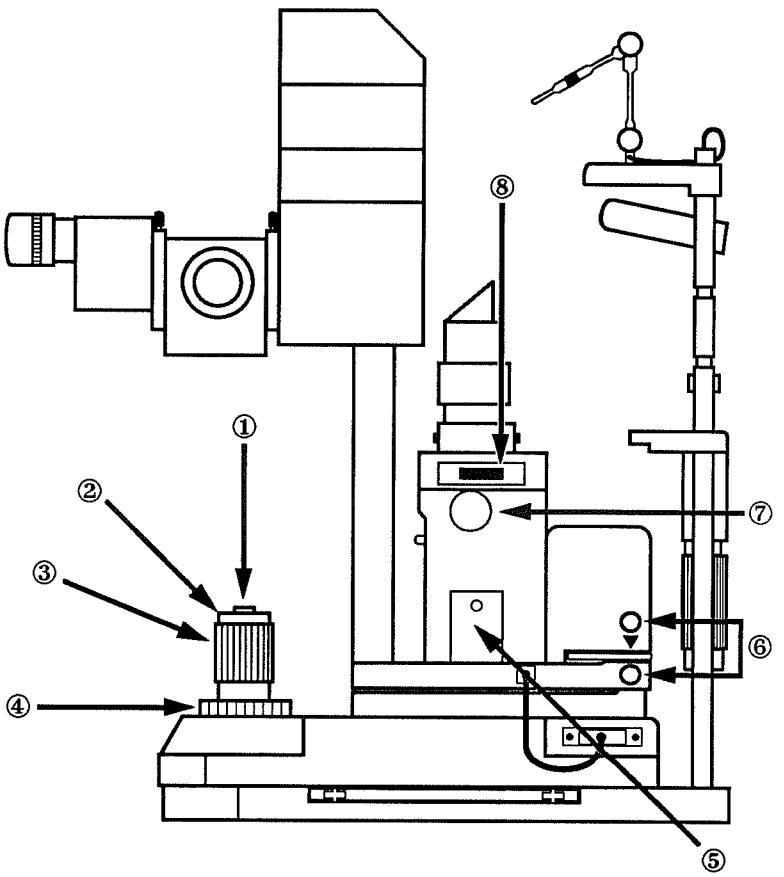
The Slit Prism knobs lock the angle to which the slit prism has been moved.

Slit Width Adjustment

The Slit Width adjustment controls the width of the slit.

Decentration Lever

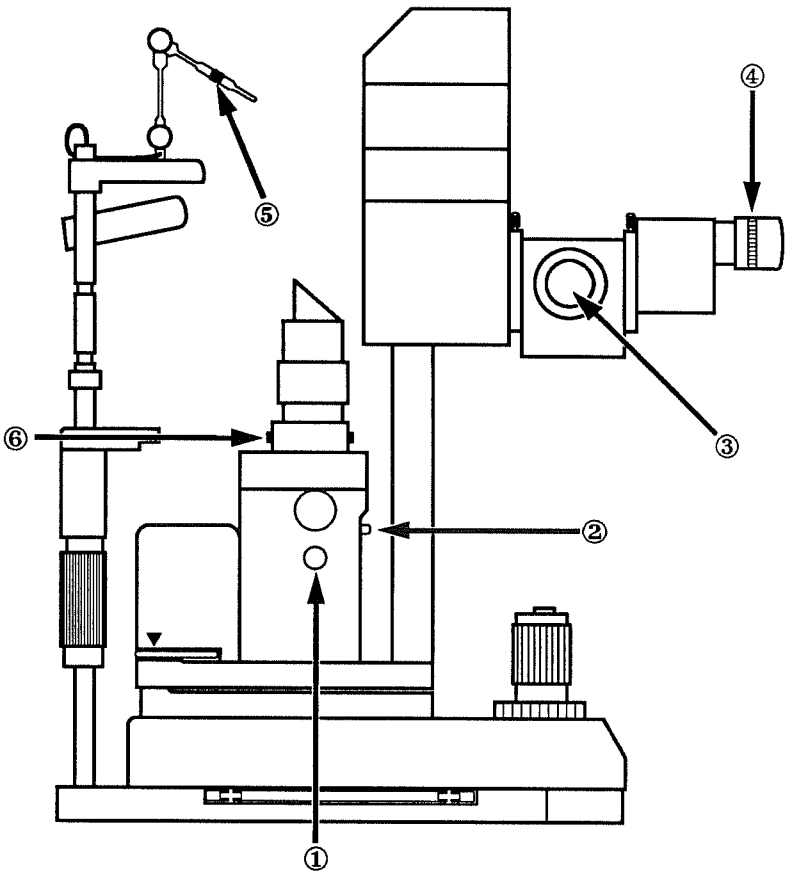
The Decentration lever is located on the right side of the slit lamp prism assembly. Moving this lever moves the slit from side to side.



① Firebutton
② Joystick
③ Joystick Elevation Ring
④ Joystick Lock
⑤ Light Bulb Housing Door
⑥ Slit Prism Locks
⑦ Slit Width Adjustment
⑧ Decentration Lever

LDS-10 Slit Lamp Controls and Indicators
View A
(For use with 7970)

Filter Knob	Pushing in or pulling out on the Filter knob changes the filter back and forth from blue cobalt filter glass to clear filter glass. Pushing in on the knob produces white light; pulling on the knob produces blue light.
Slit Aperture Size Adjustment	The Slit Aperture Size Adjustment controls the size of the slit.
Magnification Changer	The Magnification Changer knob selects the magnification power of the visual system.
Diopter Adjustment	The Diopter eyepieces may be rotated to provide correction to the visual system for the operator's eyesight characteristics.
Fixation Light Color Switch	Fixation Light Color Switch changes the color of the fixation light to red or green.
Slit Rotation	Slit Rotation provides for continuous adjustment of the slit between vertical and horizontal orientation.



① Filter Knob
② Slit Aperture Size Adjustment
③ Magnification Changer
④ Diopter Adjustment
⑤ Fixation Light Color Switch
⑥ Slit Rotation

LDS-10 Slit Lamp Controls and Indicators
View B
(For use with 7970)

Coherent LDS-20 Slit Lamp Controls and Indicators

The LDS-20 is used with 7901 Nd:YAG. See figures entitled "LDS-20 Slit Lamp Controls and Indicators View A"and "LDS-20 Slit Lamp Controls and Indicators View B."

Micromanipulator

Moving the Micromanipulator moves the argon laser beam to the target. Its computer-controlled design provides fast and accurate tissue targeting. The Micromanipulator controls the prism head optics for precise placement of the laser beam, independent of the viewing optics. (The Micromanipulator is for placement of the laser beam from an argon system only. It does not move the Nd:YAG beam.)

Joystick

The Joystick is a vertical lever rising from the base of the slit lamp on the physician's side of the table top which allows the entire laser head to be moved in any horizontal direction.

- Gross Movements. When large movements are required, i.e., moving from one eye to the other, the joystick should be used as a handle to slide the whole unit over.

- Fine Movements. When fine, controlled movements are required, i.e., focusing the instrument to the treatment site, the joystick should be merely tilted.

Joystick Elevation Ring

When up or down movements are required, turn the Joystick Elevation Ring.

Joystick Lock

The Joystick Lock is a ring located at the base of the Joystick. To lock the Joystick in position turn clockwise; to unlock turn counterclockwise.

Enable/Disable Push Button

The Enable/Disable push button turns the micromanipulator on or off. If the Micromanipulator is not used for 2.5 minutes, it automatically turns off. The indicator light on top of the push button illuminates green when the Micromanipulator is enabled and extinguishes when the Micromanipulator is disabled.

Light Bulb Housing Door

The Light Bulb Housing door is used to access the slit lamp bulb when the light needs to be changed.

Slit Prism Locks

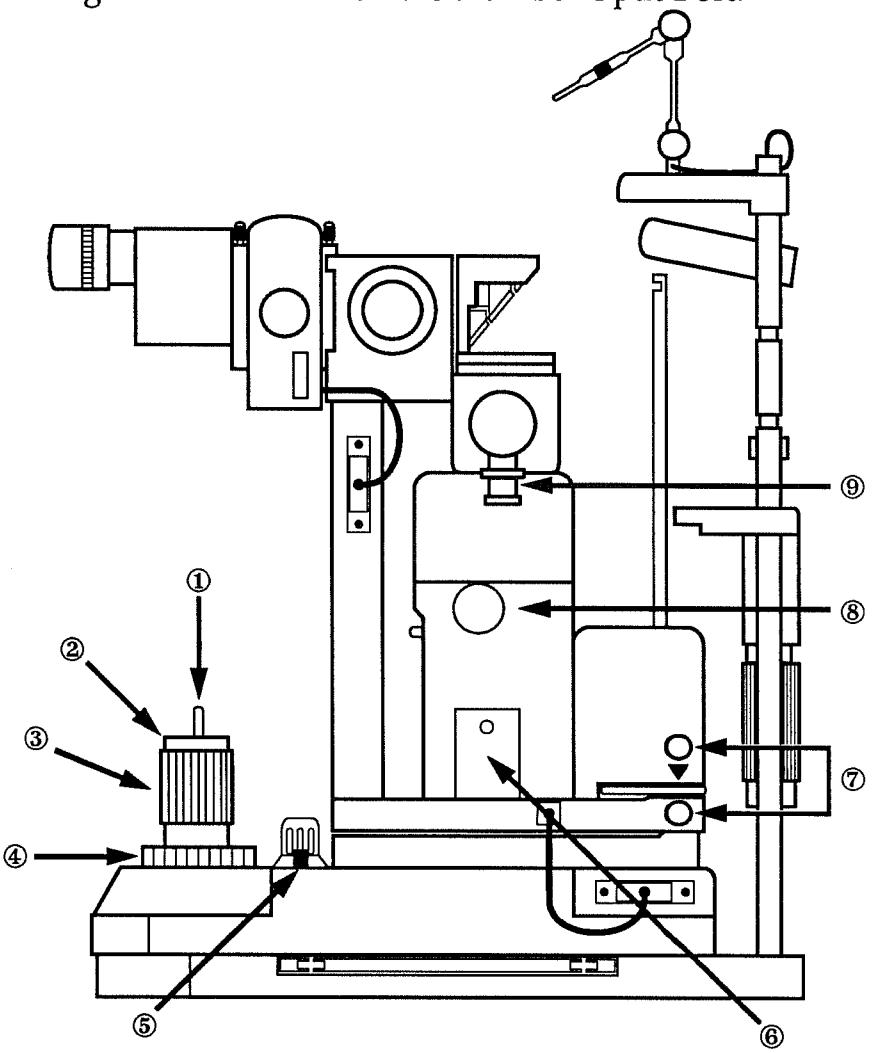
The Slit Prism knobs lock the angle to which the slit prism has been moved.

Slit Width Adjustment

The Slit Width adjustment controls the width of the slit.

Fiber Optic Port

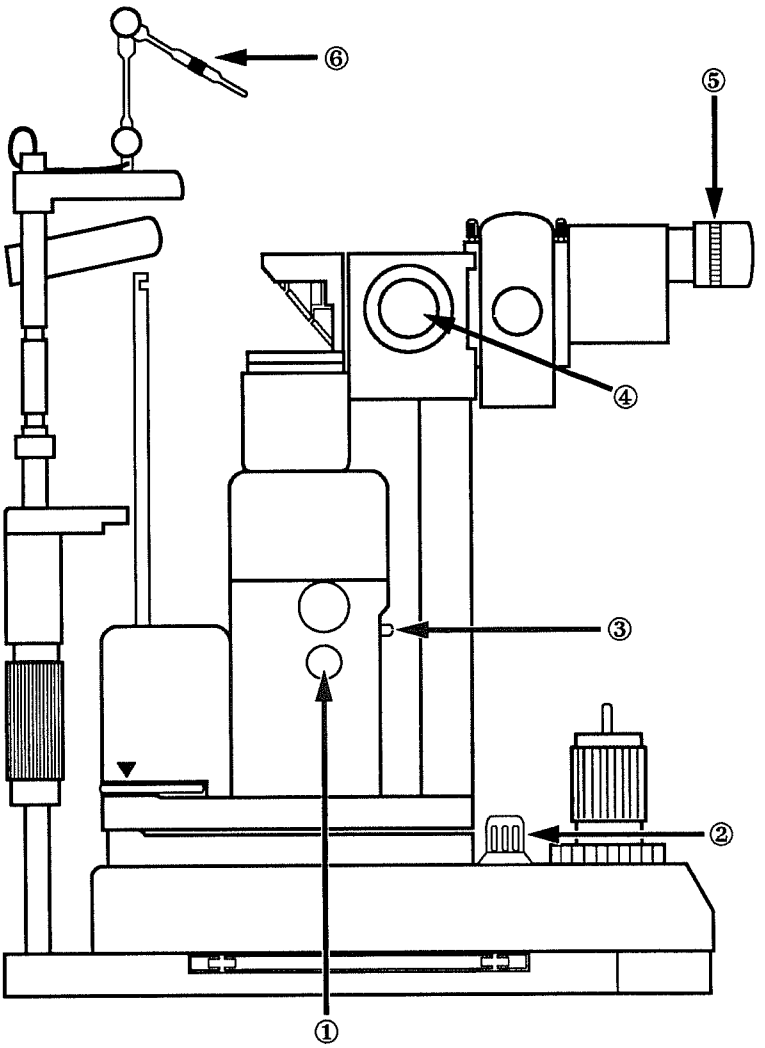
The receptacle for attaching the fiber optic from the argon laser to the LDS-20 is the Fiber Optic Port.



① Micromanipulator
② Joystick
③ Joystick Elevation Ring
④ Joystick Lock
⑤ Enable/Disable Push Button
⑥ Light Bulb Housing Door
⑦ Slit Prism Locks
⑧ Slit Width Adjustment
⑨ Fiber Optic Port

LDS-20 Slit Lamp Controls and Indicators
View A
(For use with 7901)

Filter Knob	Pushing in or pulling out on the Filter knob changes the filter back and forth from blue cobalt filter glass to clear filter glass. Pushing in on the knob produces white light; pulling on the knob produces blue light.
Slit Lamp Illumination Switch	The Slit Lamp illumination switch, located to the right of the Joystick, is rotated clockwise to brighten and counter-clockwise to dim slit lamp illumination.
Slit Aperture Size Adjustment	The Slit Aperture Size Adjustment controls the size of the slit.
Magnification Changer	The Magnification Changer knob selects the magnification power of the visual system.
Diopter Adjustment	The Diopter eyepieces may be rotated to provide correction to the visual system for the operator's eyesight characteristics.
Fixation Light Color Switch	The Fixation Light Color switch changes the color of the fixation light to red or green.



① Filter Knob
② Slit Lamp Illumination Switch
③ Slit Aperture Size Adjustment
④ Magnification Changer
⑤ Diopter Adjustment
⑥ Fixation Light Color Switch

LDS-20 Slit Lamp Controls and Indicators
View B
(For use with 7901)

Specifications*

System Configuration	
7970	Comprised of Optics Module, Electronics Module, Slit Lamp Assembly, Power Table, and Control Panel
7901	Comprised of Optics Module, Control Panel, and free-standing Electronics Module
Combination System Configuration	
7931	Comprised of 7901 Nd:YAG Laser, LDS-20 Delivery System, and 930 Argon Laser
7921	Comprised of 7901 Nd:YAG Laser, LDS-20 Delivery System, and any one of the Coherent photocoagulators (900, 910, 920 Argon, 920 Argon/Krypton, or 920 Argon/Dye)
Laser	Q-switched Nd:YAG at 1064 nanometer
Mode	Fundamental
Pulse Duration	3 nanoseconds
Spot Size	< 7 microns
Cone Angle	16 degrees
Working Distance	115 millimeters
Pulse Train	Single, double, or triple pulse (burst)
Pulse Separation in Burst Mode	< 50 microseconds
Repetition Rate	2 pulse/second or 3 pulse burst/3 seconds
Aiming Beam	Twin helium neon (HeNe) aiming beams
Intensity	Three intensities, selectable
Focus Offset	167 microns HeNe anterior to Nd:YAG focus
Cooling System	Convection

Pulse to Pulse Stability	± 20% (energy)
Energy Values	Continuously variable, 10 mJ per pulse (maximum)
Saline Breakdown	> 50% at lowest energy setting
Slit Lamp	
7970	Coherent LDS-10 Slit Lamp Delivery System
7901	Coherent LDS-20 Slit Lamp Delivery System
Fixation Lamp	2 colors, red and green
Electronics	
Input Voltages	115/230 VAC, 50/60 Hertz, 4 amps maximum
Main Key Switch	Yes
Remote Interlock	Yes
Safety Filter	Safety filter for Nd:YAG energy; optical density of 6 at 1064 nanometer
Controls and Indicators	Conveniently located for easy access
Pulse Counter	Cumulative counter sums pulses between resets; total energy also displayed
Magnification	12.5x and 30x (standard) 5x, 8x, 12.5x, 20x, 30x (optional)
System Operating Temperature	10°C to 30°C
Dimensions	
Table Top Size (7970)	37 x 24 inches: 94.9 x 60.9 centimeters
Floor Space (7970)	26.5 x 34 inches: 67.3 x 86.4 centimeters
Unit Weight	
7970	245 pounds
7901	50 pounds maximum (slit lamp weight not included)

* *Specifications subject to change without notice.*

Accessories

The following accessories are available for use with the 7970 and 7901 and can be purchased either through the manufacturer or your Coherent Service Representative.

Safety Glasses

Safety glasses (Coherent Part No. 3303-0092 or 3303-0133) should be provided for use by all personnel except those viewing the operation solely through the laser viewing system which incorporates a safety filter system (see Section 2, "User Eye Protection").

Ocular Accessories

Adapters are available which allow use of some Zeiss viewing and photographic accessories.

Nd:YAG Contact Lenses

Several Nd:YAG contact lenses are available from Coherent.

For Iridectomy

Abraham
Nd:YAG
Iridectomy Lens
(Coherent Part Number: 3803-0206)

Wise
Iridectomy/Sphincterotomy
Argon/Nd:YAG Lens
(Coherent Part Number: 0610-329-01)

For Posterior Capsulotomy

Lens Type (Coherent Part Number)	Magnification (Relative to No Contact Lens)	Maximum Treatment Diameter*
Abraham Nd:YAG Laser Lens (3803-0179)	1.65	3.2 mm
12.5 mm Peyman Wide Field Nd:YAG Laser Lens (3803-0186)	1.00	8.0 mm
12.12 Peyman Capsulotomy Nd:YAG Laser Lens (0611-146-01)	1.48	7.6 mm
18 mm Peyman Wide Field Nd:YAG Laser Lens (3803-0183)	0.85	8.0 mm
25 mm Peyman Wide Field Nd:YAG Laser Lens (3803-0180)	0.80	8.0 mm

* Diameters measured in air when at normal incidence angles to the contact lens and patient's eye. The magnification and diameter of the contact lens may limit the treatment area unless adjusting the laser delivery angle.

Section 5

Operation

CAUTION
Federal law restricts this device to sale to or on order of a physician.

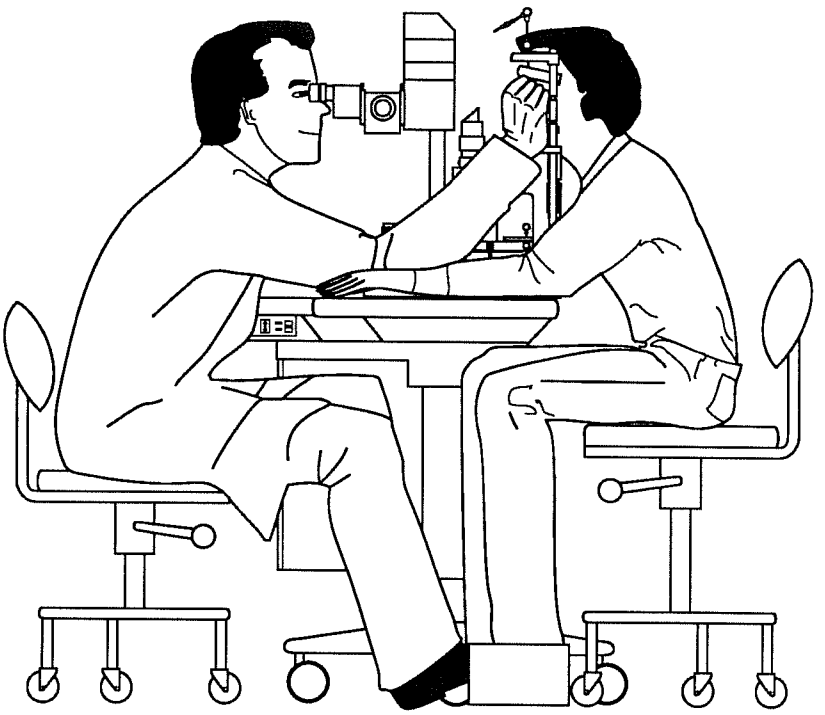
Protective Measures

Nd:YAG lasers generate a highly concentrated, invisible beam of light which can be dangerous if improperly used. Before operation of the laser system, carefully read and comprehend all preceding sections, particularly the "Safety" and "Indications For Use" sections.

Patient Preparation

During treatment, the physician should be seated with easy and comfortable access to the microscope and system controls.

The 7970 and 7901 slit lamp, chin rest assembly, and lift table are adjustable. After the patient is seated, adjust the motorized lift table to the appropriate height using the Raise/Lower switch. Then adjust the chin and head rests to orientations comfortable to the patient. A head restraint may be used to keep the patient's head firmly in place.

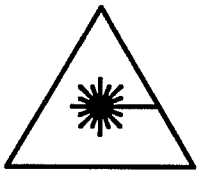


Patient Adjustment

System Alignment

If there is any question about the optical alignment of the system or if the physician wants to confirm the ocular settings for his refractive error, the alignment should be verified as instructed in Section 6, "Optical Alignment Verification".

System Turn-On



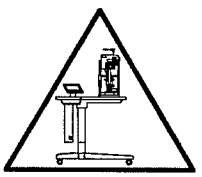
WARNING

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

System turn-on is identical for both the 7970 Nd:YAG and the 7901 Nd:YAG. See Section 4 for the location of controls and indicators referred to in these instructions. If a fault message or service message should appear during turn-on, refer to Section 6, "Troubleshooting Guide".

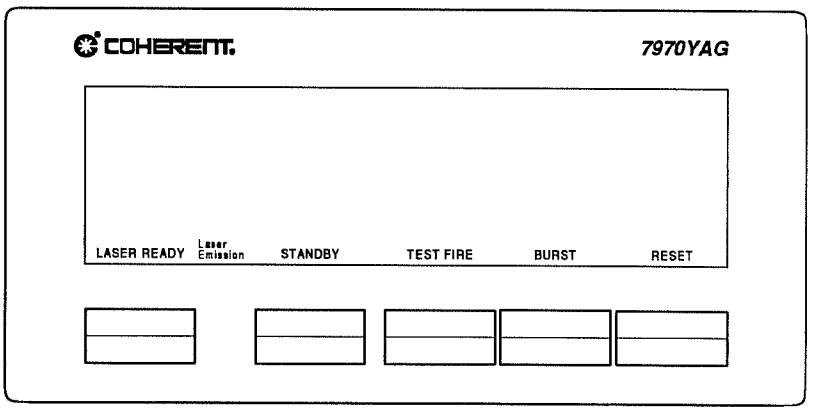
System Power On/Off

Insert the key into the System Power On/Off key switch and turn it clockwise to the On position. "Laser Emission" will illuminate on the Control Panel to inform the user of possible laser radiation.



NOTE

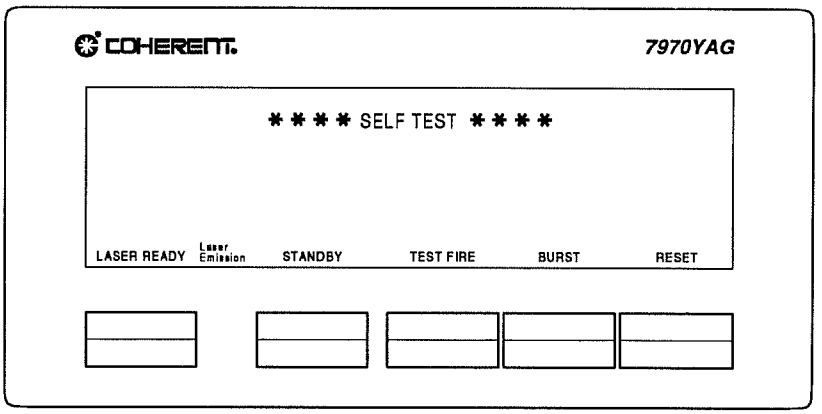
The Control Panel displays in this manual are representations, not replicas. The shapes of characters will appear differently on the Control Panel Display.



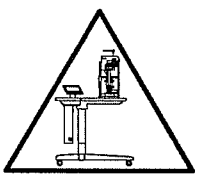
"Laser Emission" Indicator and Control Panel Buttons

Self Test

"SELF TEST" will appear in the Control Panel Display while the system performs a sequence of tests to check safety circuits, etc. This process takes about five seconds.



"SELF TEST" Display



NOTE

If your system does not have the optional Firebutton, please proceed to "Test Fire".

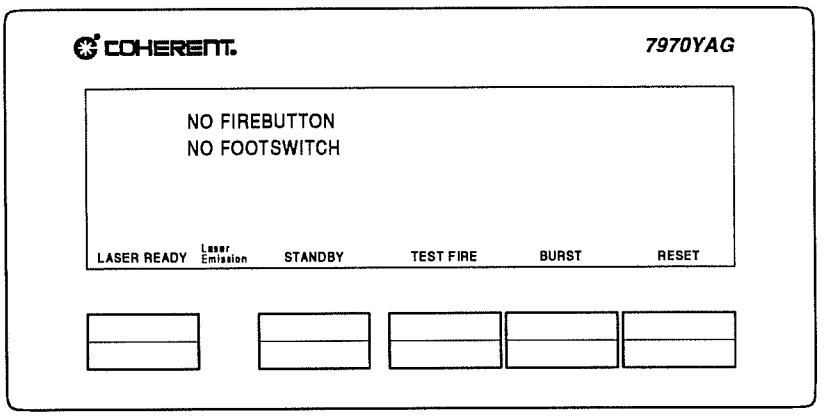
Selection Of Footswitch Or Firebutton (7970 ONLY)

After the self test, you will be able to select the device you prefer for firing the laser: Footswitch or Firebutton. While the system is operational, only the selected device will fire the laser. The inactive device is ignored and will not fire the laser if pressed. However, if the inactive device is pressed and held down for more than 1.5 seconds, a "SERVICE #7" error will appear on the display. This is a general error indicating a malfunction of the Footswitch or the Firebutton (i.e., switch shorted). To restart, turn the Power On/Off key switch to Off, then, after waiting two seconds, to On.

The selection function is accessible only at turn on; the user cannot change his or her selection unless the power is turned off and back on.

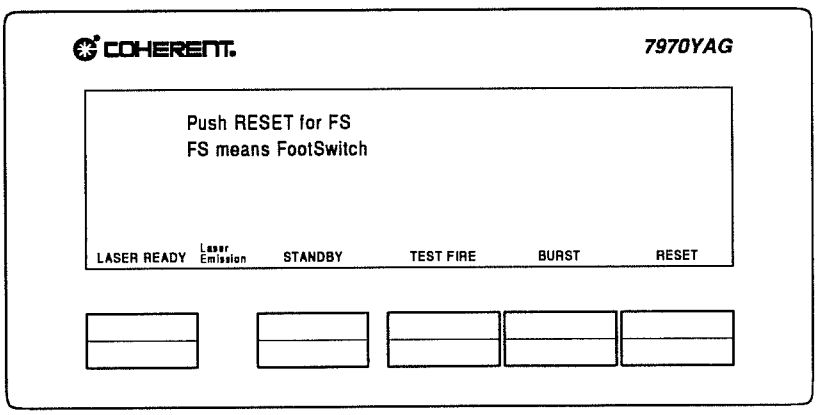
The system stores in memory the device or devices (Footswitch, Firebutton, or both) which were connected when the system was last turned on. When the unit is turned on again, it will determine what is currently connected to the system. If neither the Footswitch nor

the Firebutton is connected, the system will display the error message below.

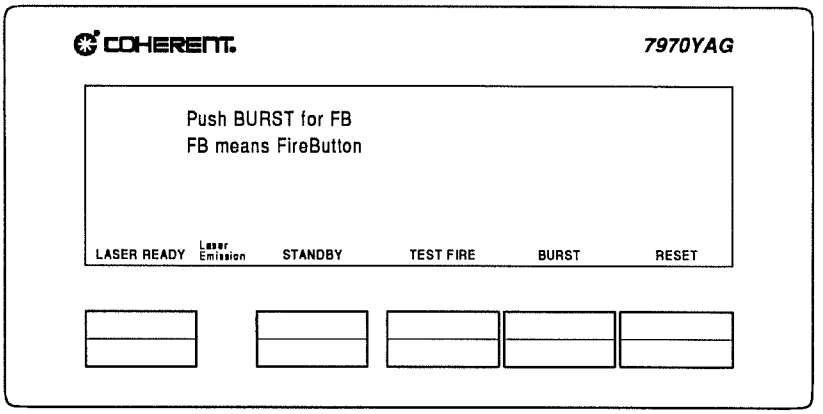


Configuration Error Display

If both the Footswitch and the Firebutton are connected, two menu messages will be displayed alternately. The first menu asks you to press the Reset switch on the front panel to select the Footswitch (see figure entitled "Menu 1: Footswitch Selection Display"); the second menu asks you to press Burst to select the Firebutton (see figure entitled "Menu 2: Firebutton Selection Display"). Note that the Reset and Burst switches now have different functions than they do during normal system operation.

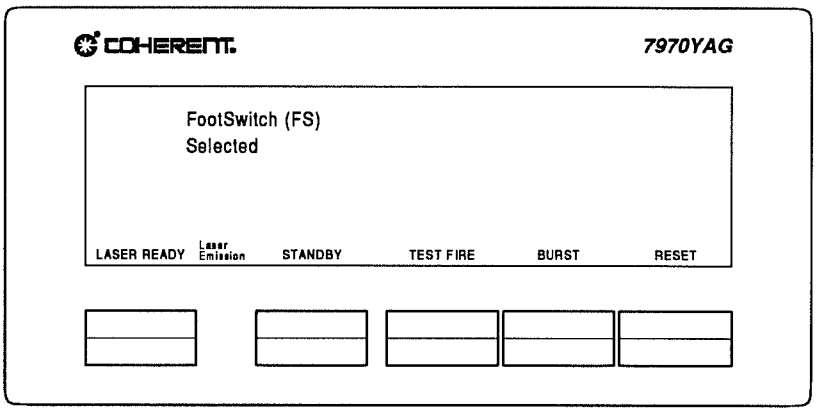


Menu 1: Footswitch Selection Display

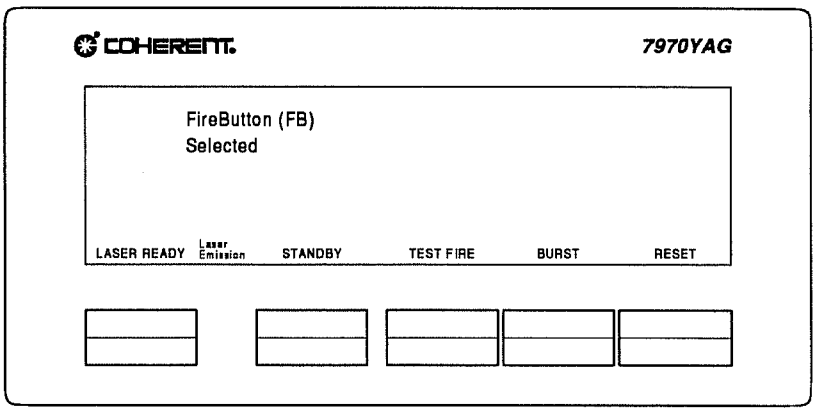


Menu 2: Firebutton Selection Display

The Control Panel Display will alternately show the above menus for two seconds each until either the Reset or Burst switch is pressed. Pressing the Reset switch selects the Footswitch and pressing the Burst switch selects the Firebutton. After the selection has been made, the display will show which device has been selected:



Menu 3: Footswitch Selected Display

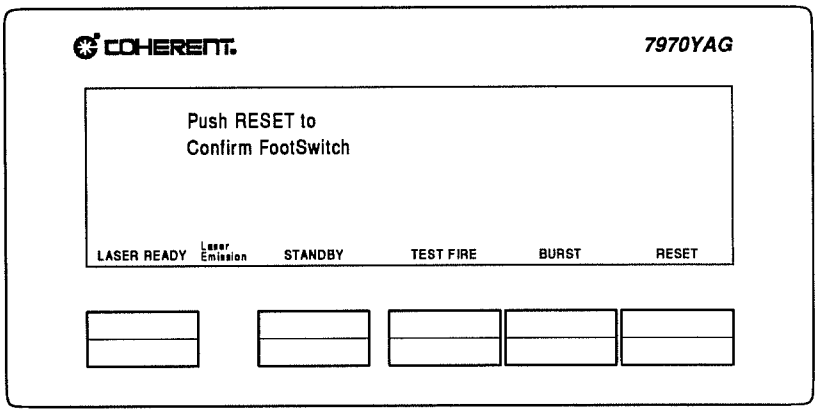


Menu 4: Firebutton Selected Display

"Menu 3" or "Menu 4" will be displayed for about two seconds, and then the system enters the Standby mode.

Footswitch ONLY or Firebutton ONLY Configurations

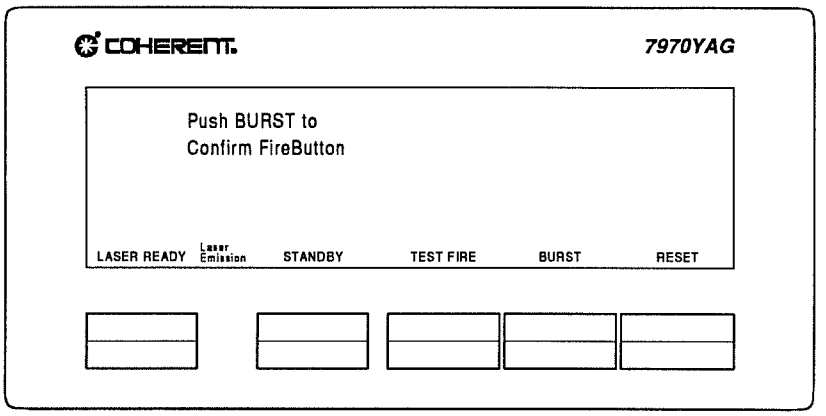
If the system memory detects that the Footswitch is the only device connected, the system will automatically go into the Standby mode. An operator who always uses the Footswitch, and has only the Footswitch connected, will not need to make a selection every time the system is turned on. However, if the Firebutton was previously connected, or if the previously selected device was not the Footswitch, then the "Footswitch Confirmation Menu Display" appears (see below).



Footswitch Confirmation Menu Display

Pressing Reset selects the Footswitch, and the system enters Standby. The confirmation menu serves one of two purposes: it makes the user verify that the set-up has been intentionally changed, or, it indicates a fault in the system detecting the Firebutton.

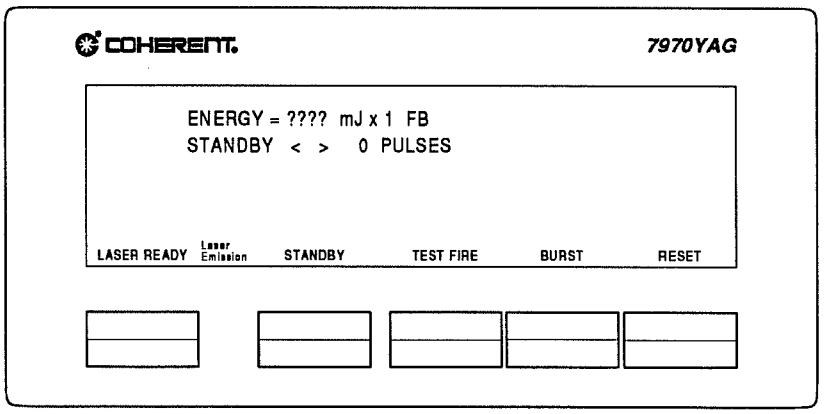
If the system detects that only the Firebutton is connected, the "Firebutton Confirmation Menu Display" will appear (see below).



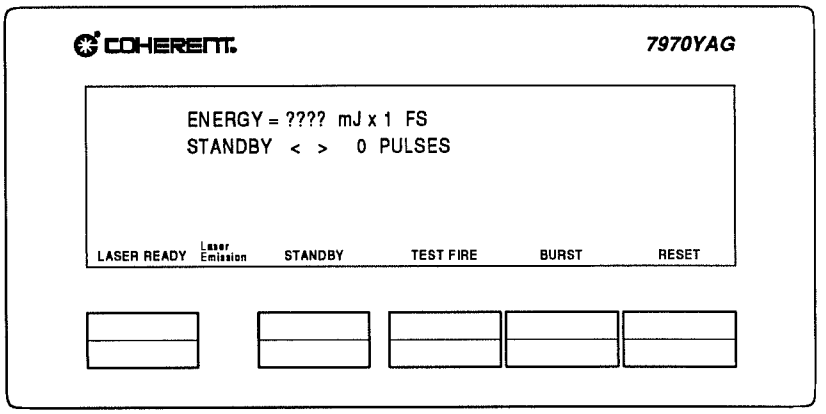
Firebutton Confirmation Menu Display

Pressing Burst selects the Firebutton, and the system enters the Standby mode.

After the system enters the Standby mode, a "FB" (Firebutton) or "FS" (Footswitch) will appear at the end of the upper display row to indicate which device is selected (see below). The indicator is also displayed when the system is in the Ready mode.



Display Panel When Firebutton Is Selected



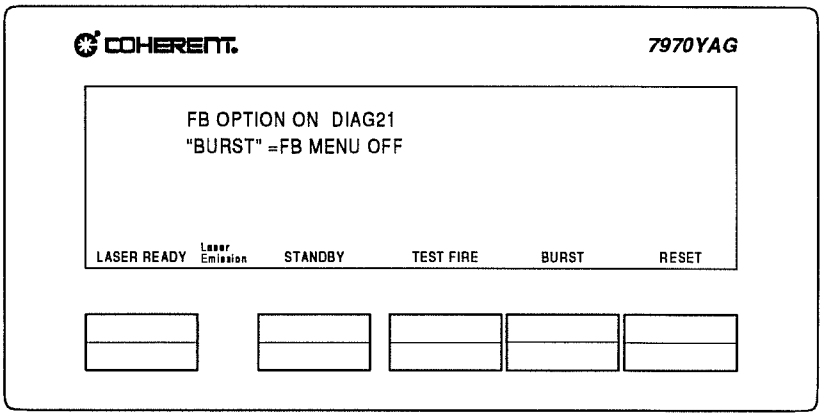
Display Panel When Footswitch Is Selected

Footswitch ONLY Or Firebutton ONLY Selection

If the operator wishes to use only the Firebutton, they can physically disconnect the Footswitch from the system and the system will skip the selection menus on all subsequent system power-up cycles. However, the Firebutton and its circuitry cannot be disconnected by the user. Because both the Footswitch and the Firebutton will be detected when the system is turned on, the user will always be asked to make a selection. To remove this inconvenience the user can activate a diagnostic function (Diagnostic #21) which will simulate disconnecting the Firebutton from the system. This function can be activated by:

1. Pressing Reset, Burst, and Laser Ready simultaneously.

Disabling the Firebutton menu is equivalent to actually disconnecting the Firebutton, if the Footswitch is connected, the system will function exactly as in Footswitch only configuration.



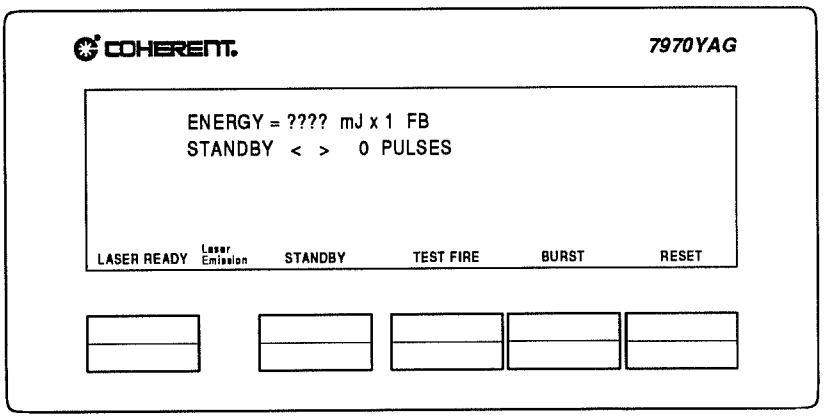
Diagnostic #21 Display

In the figure above, the upper display row indicates whether the Firebutton option is enabled or disabled. The lower display row indicates what will happen if Burst is pressed. In the above example, pressing Burst will turn off the Firebutton menu, which simulates disconnecting the Firebutton. Since the Burst switch also toggles the control setting, the above display implies that the Firebutton menu is currently turned on. If Burst is pressed, the menu will be suppressed on the next system turn-on. If Reset is pressed, the Firebutton/Footswitch menu will appear on the next system turn-on.

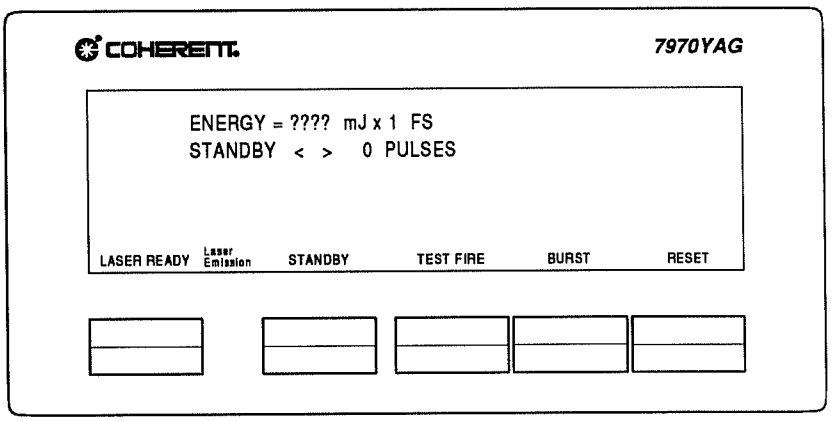
After the setting has been changed, the system will return to the Standby mode. As with all other diagnostic functions, the Reset switch may be pressed to leave the current setting as is and return to Standby. Note that if the Firebutton option is disabled (i.e., off) the Burst switch will have no effect, as the menu will automatically be turned off and cannot be turned on.

Test Fire

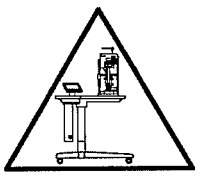
After self test (and after Footswitch/Firebutton selection if applicable), one of the following displays will appear. You may test fire the system to determine the amount of energy that will be delivered when the unit is returned to the Ready mode.



Energy/Standby Display (Firebutton)



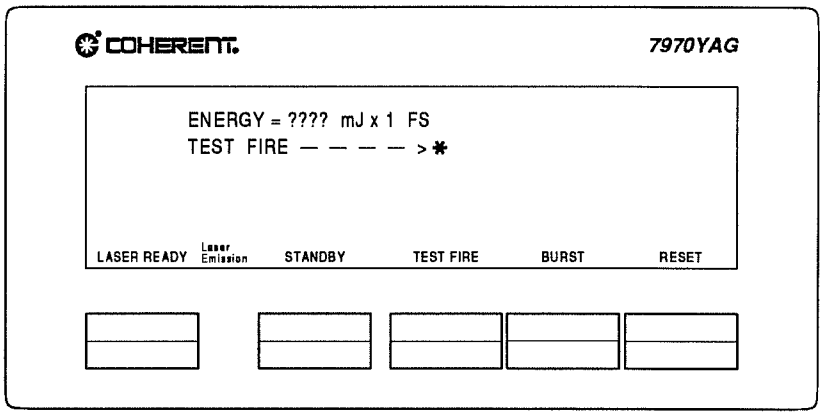
Energy/Standby Display (Footswitch)



NOTE

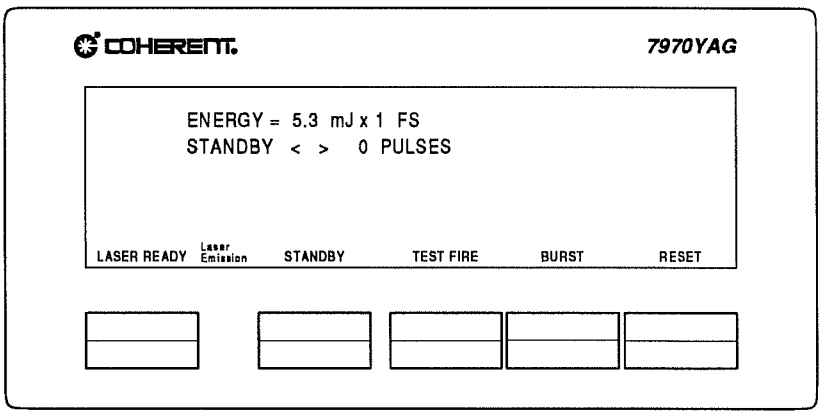
From this point on, all display diagrams in this section will show "FS" (indicating a choice of Footswitch beam delivery). Should you choose Firebutton delivery, "FB" will appear instead of "FS". All other display characters are the same in both delivery modes.

Press the Test Fire button. The laser will fire while the safety shutter remains closed. "TEST FIRE" will momentarily appear on the Control Panel display.



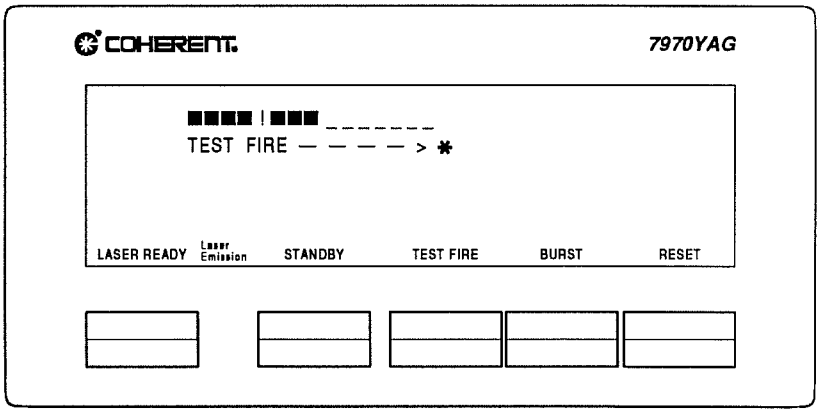
Test Fire Display

After the "Test Fire Display" the "Energy Level Display" will appear (see below).



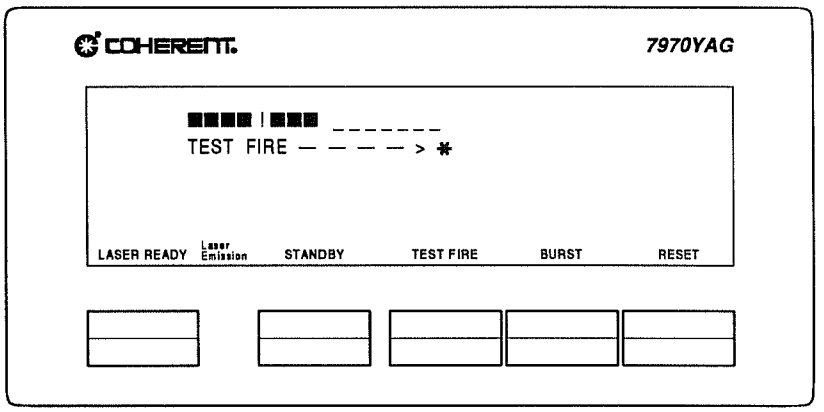
Energy Level Display

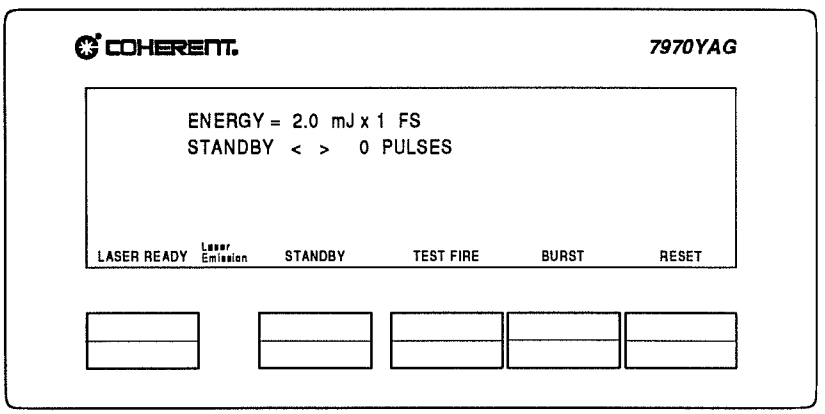
Turn the Energy Control attenuator, located on the Optics Module, to select the desired energy level. As the Energy Control attenuator is moved, the Control Panel Display will render a bar graph showing the relative position of the attenuator (see figure entitled "Energy Control Bar Graph"). The bar is made up of a possible 20 squares. The squares move back and forth along the display as you move the attenuator.



Energy Control Bar Graph

When the attenuator is stopped at a position for more than 1.5 seconds, the laser automatically performs a test fire and displays the new energy level. Each time the Energy Control attenuator is reset, a test fire will automatically be performed and the new energy level will be displayed. The position of the exclamation point along the bar corresponds to the relative position where you started.

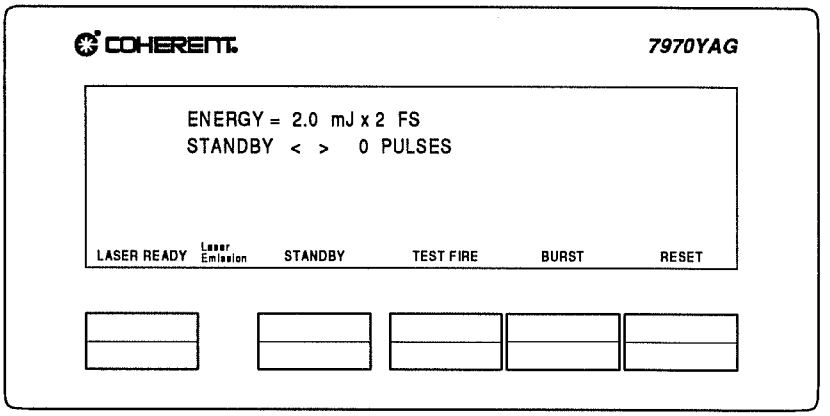




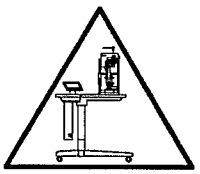
Test Fire (above) After Reset of Energy Control Attenuator and Energy Control Display (bottom) of Test Fire

Burst Selection

The number of treatment pulses per burst (from one to three) can be selected using the Burst button on the Control Panel. Each depression of the Burst button increases the number of pulses per burst by one. At the three pulses per burst position, pressing the Burst button returns the setting to one pulse per burst. Each time the Burst selection has been changed and remains in the new setting for more than 1.5 seconds, the laser automatically performs a test fire and displays the new energy level ("X1", "X2", or "X3") in the upper display row. One pulse per burst is the default setting for the 7970 and the 7901.



Burst Display

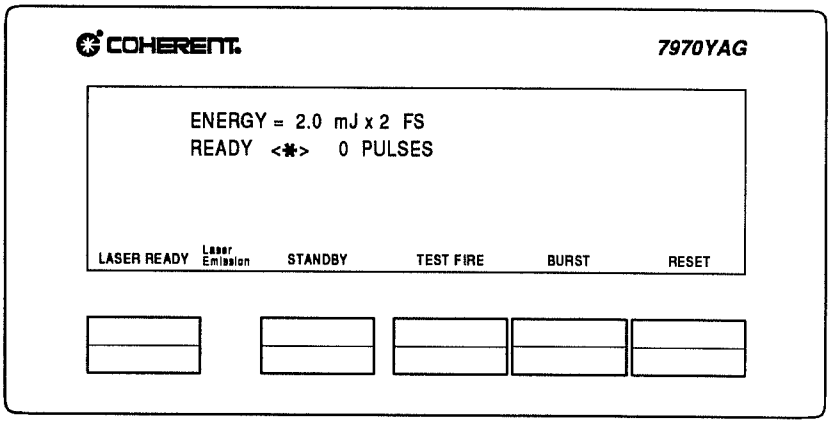


NOTE

The preceding figure shows the amount of energy delivered per pulse. The total energy delivered in a burst is the energy per pulse multiplied by the number of pulses in a burst. In the above figure, the total energy delivered is 4 millijoules.

Ready Mode

After you have selected the desired energy level and burst number; and are ready to begin treatment, press the Laser Ready button. If a test fire has not already been attempted at the current energy level, the system automatically performs a test fire and displays the energy level status. If the aiming beam has not previously been selected, the aiming beam emission indicator "*" also appears at this time. The aiming beam may be toggled on and off by pressing the Standby button while in Standby mode.



Aiming Beam Emission Indicator ""*

Nd:YAG Slit Lamp Focusing

The following focusing procedure should be performed before each treatment.

1. Lower the focusing flag into view or tape a piece of paper to the slit lamp.

2. Set the Magnification Changer to 30X.

3. Ensure that the aiming beam is on (toggle the Standby push button).

4. Using the joystick, bring the aiming beam spots clearly together on the focusing surface (i.e.: the black matte paint of the focus flag or on the paper taped to the slit lamp).

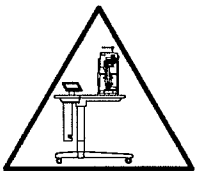
HeNe Focus

5. Adjust the oculars going from plus to minus to prevent accommodation. **The dual HeNe aiming beams should be coincident. The aiming beams and background field should be in sharp focus.**

Optical Focus

6. Set the Magnification Changer to 12.5X and adjust the field to clear focus if necessary. Hold the slit lamp in a fixed position so the HeNe aiming beams remain concentric.

7. Reconfirm at 30X that the adjustments at low power still maintain a clearly visible, focused background field with the HeNe aiming beams concentric.



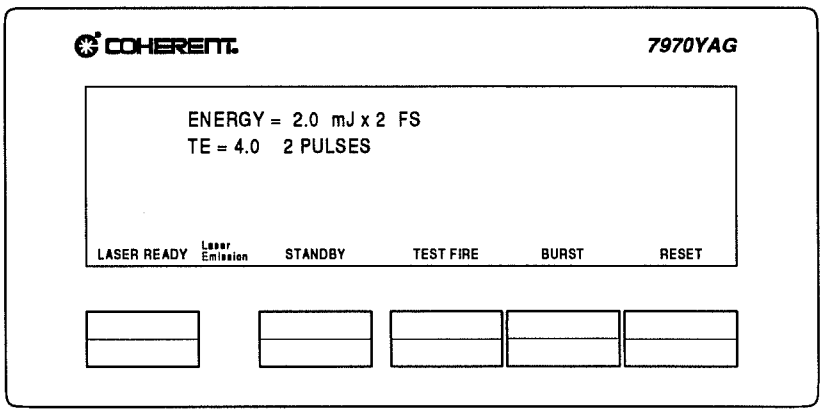
The laser is now available for treatment.

NOTE

You may return to the Standby condition from the Ready condition by pressing either of the following buttons: Laser Ready or Standby.

1. Refer to Section 3, "Aiming Instructions" for instructions on aiming and focusing.

2. Depress the Footswitch (or press the Firebutton). After firing, the display will show the energy delivered per pulse, the number of pulses per burst, the total energy (TE) delivered, and the total number of pulses delivered (see figure entitled "Total Energy (TE)/Total Pulses Display" below). The TE is derived by adding together the energy from each burst. Energy levels can be changed between each burst. This feature is an advantage to those physicians who wish to keep track of the total energy delivered to a treatment site.



Total Energy (TE)/Total Pulses Display

3. Reset the total energy (TE) and pulse count to zero (0) by pressing the Reset button.

Treatment Procedure

Consult Section 3, "Indications For Use: Posterior Capsulotomy and Pupillary Membranectomy" and "Indications For Use: Iridotomy" for recommendations on specific treatment procedures.

Energy Settings

As a general practice, the energy settings for treatment should be the lowest necessary to perform the treatment.

Treatment Approach

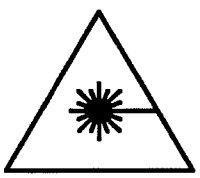
The physician should select the treatment approach desired.

Use of Contact Lens

A Nd:YAG contact lens is recommended for some treatments in order to minimize risk to non-target sites such as the cornea and IOL; and to stabilize the patient's eye. Since contact lenses alter the energy density at the treatment site, the energy setting should be readjusted.

Aiming and Illumination

The focal point of the invisible Nd:YAG working beam is set posterior to that of the visible HeNe aiming beams. The focus of the aiming beams is accurately located by finding the plane at which the two red spots merge into a single spot. Better depth perception results when the slit lamp illumination is positioned slightly off-axis to the HeNe aiming light. The most useful magnification setting should be selected.



WARNING

The maximum safe power that can be visualized indefinitely by the retina is 0.39 microwatts (Class I). The HeNe laser that produces the aiming beam is a Class II laser. Direct patient visualization of Class II laser radiation has not been shown to be safe. To protect the patient from possible retinal damage, use the lowest practical aiming beam intensity during treatment.

The power levels provided by the aiming beam intensity control and their corresponding safe exposure limits are given below:

Beam Attenuation	Aiming Beam Power	Class I Exposure Duration Limit
●	.004 milliwatts (4 microwatts)	975 seconds
●	.012 milliwatts (12 microwatts)	325 seconds
●	.05 milliwatts (50 microwatts)	78 seconds

Firing the Laser

When the system is in the ready mode and the Footswitch or Firebutton is depressed, the laser will fire. The safety shutter will open with an audible "click" and Nd:YAG laser energy will be delivered to the treatment site. As soon as the energy has been delivered, the safety shutter will close. The treatment cycle may be repeated after the Footswitch has been released and the ready indicator audible tone is heard.

The 7970 or 7901 will deliver the selected number of pulses with each depression of the Footswitch or the Firebutton. The physician will know if the laser has fired because of the audible "click." Firing can also be verified by the pulse counter, which will change only when the laser actually fires.

System Turn-Off

When treatment is complete or is to be interrupted:

1. Turn the System Power On/Off key switch to the Off position.

2. Remove the key from the key switch. Only authorized personnel should have access to the laser system key.

Language Selection

The 7970 and 7901 Nd:YAG lasers have been programmed to operate in six different languages: Spanish, French, Italian, Japanese, German, and English. This capability allows the physician to use and read the Control Panel in the language with which he or she is most comfortable. To select the desired language, follow the steps below:

1. Simultaneously press the Laser Ready, Burst, and Reset buttons on the Control Panel.

2. Press and hold down the Standby button. The Control Panel will show a series of Diagnostic Channels by number. Release the Standby button when Diagnostic Channel "8" appears on the display. (To return to a previously displayed diagnostic channel, press the Laser Ready button.)

3. Press and hold down the Burst button. The names of languages will appear one at a time on the display. Release the Burst button when the display shows the desired language. (To return to a previously displayed language, press the Test Fire button.)

4. Press the Reset button. The display will return to its normal functions and the Control Panel will display its prompts in the language you have chosen.

Section 6

Maintenance

Routine Maintenance

The Coherent 7970 Nd:YAG and 7901 Nd:YAG lasers have been designed to give long, trouble-free service. Very little owner maintenance is required. As with any optical instrument, cleanliness is important.

Safety and energy checks should be made at least once a year by a Coherent Service Representative (see Section 7, "Sales and Service Offices"). Safety and energy checks are as follows: energy output; energy meter calibration; laser mode and alignment; optical performance; voltage levels; and microprocessor function. Optics should be cleaned at this time if necessary.

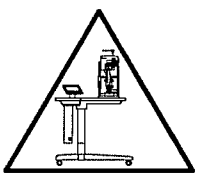
Cleanliness Of Slit Lamp And Contact Lenses

WARNING

Be sure the laser power is turned off before cleaning slit lamp optics.

When not in use, cover the slit lamp with the protective plastic cover included with the system. The slit lamp illuminator output lens and mirror, the laser output lens, and the eyepiece oculars must be kept clean. Periodically inspect these optics and clean them gently with lens tissue or a cotton swab and methanol.

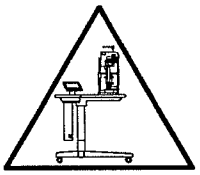
Several Nd:YAG contact lenses are available from Coherent (see Section 4, "Accessory Equipment"). Warm soapy water is the best way to keep these lenses clean without damaging them. (If there are questions regarding sterilization involving specific pathogens, contact the Center for Disease Control [CDC] in Atlanta, Georgia or the American Academy of Ophthalmology in San Francisco, California.)



CAUTION

The contact lenses must be handled carefully and should not be cleaned with solvents.

Optical Alignment Verification



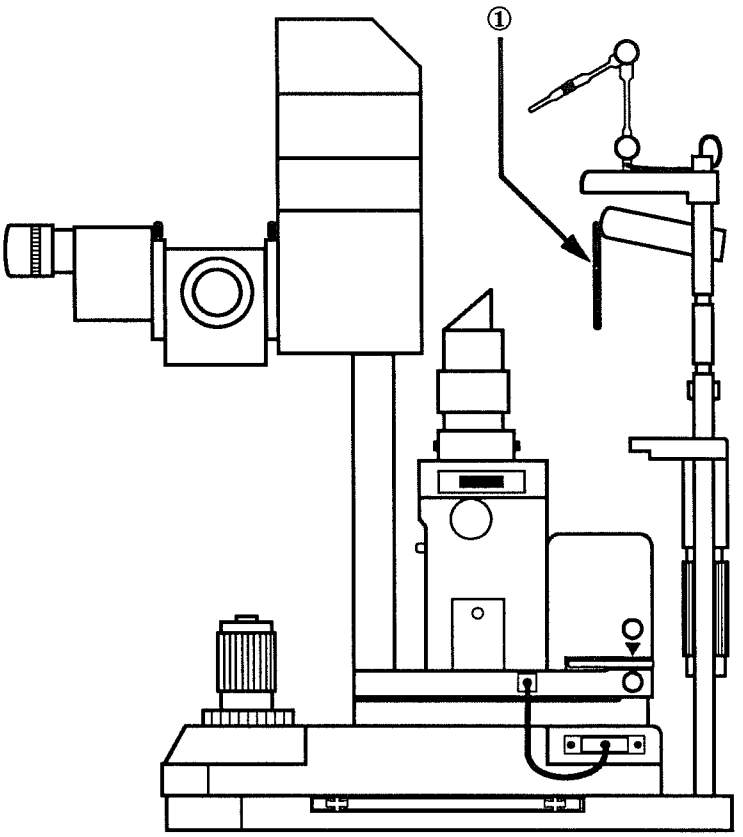
The following instruction are to be used in conjunction withthe following "Mounted Paper Target" and "System Controls" figures.

NOTE

This procedure should be done every three months or whenever it is deemed necessary by the operator of the instrument.

1. Energize the system (See Section 5, "System Turn-On").

2. Mount a piece of black paper or Zap-It paper (available from Kentek Corporation, Siel Road, Pittsfield, N.H. 03263, Telephone: 603-435-7201) on the forehead rest of the chin rest assembly (see figure entitled "Mounted Paper Target").



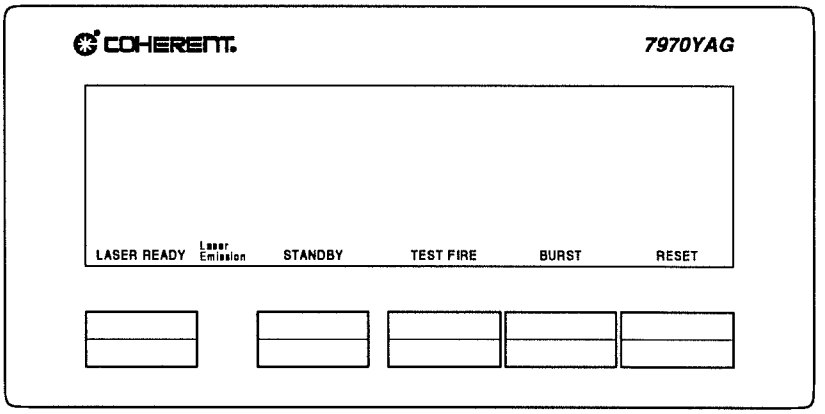
① Black Paper Mounted to Forehead Rest

Mounted Paper Target

3. Press the Standby button.

4. Press the Laser Ready button.

5. Set Energy Control attenuator to a low setting (i.e., 1 to 2 millijoules).

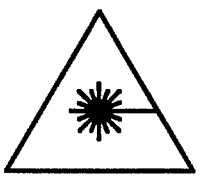


System Controls

6. Using the slit lamp, illuminate the red aiming beam spots with the output from the slit lamp. Move the slit lamp so the white light illumination beam shines on the red spots of the HeNe aiming beam.

7. Position the slit lamp and laser head assembly with the Joystick so the two red aiming beams are superimposed on one another.

8. Adjust one Diopter eyepiece at a time until both the aiming beams and the background are in focus at the same time.

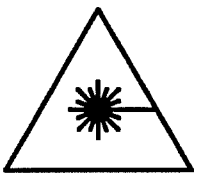


WARNING

Ensure that there are no reflective surfaces behind the paper mounted on the forehead assembly.

9. Depress the Footswitch to make a burn on the paper. (Remember that the focal point of the Nd:YAG is set posterior to the focal point of the aiming beam, providing an optimal offset for accurately focusing on the tissue to be cut.)

10. Verify that the aiming spot lies in the center of the burned area. (A large consistent burn should be achieved when focused on the paper, diminishing in size with anterior movement.) If the burn and aiming beam are positioned correctly, the system is now aligned.



WARNING

If the aiming beam is not centered, call Coherent Service (see Section 7, "Sales and Service Offices").

Energy Monitor Calibration

The energy meter ("ENERGY ????" in the upper display row) on the Control Panel is calibrated to indicate the laser energy delivered to the patient. Calibration should be adjusted only by a qualified Coherent Service Representative (see Section 7, "Sales and Service Offices"). Calibration may be readily checked with an appropriate laser energy meter. Under normal operating conditions, the Nd:YAG Control Panel energy meter should be checked for calibration once a year. Coherent Service Representatives routinely check the calibration during a service call.

To Check Calibration

The energy meter calibration can be checked with any commercially available NBS Traceable Meter mounted on the slit lamp chin rest. The internal meter should be calibrated to ± 20%.

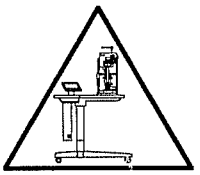
1. Mount the NBS traceable joule meter at the laser output.

2. Follow the joule meter manufacturer's directions to verify output power (directions vary according to manufacturer, make, and model).

3. The reading on the 7970 or 7901 Nd:YAG Control Panel millijoules display should agree with the NBS traceable joule meter to within ± 20%.

Calibration Procedure

The Food and Drug Administration (FDA) requires that manufacturers of Class III and IV medical laser systems supply their customers with power calibration procedures.



DISCLAIMER WARNING

Calibration is a SERVICE procedure to be done ONLY by trained Coherent Service Engineers or customers who have taken and passed a Coherent Service Certification Training course. (Service Certification Training is available to qualified customers at least twice yearly.) Calibration by anyone other than a trained Coherent Service Engineer or a certified customer will void any existing warranty on the instrument. This calibration procedure was written specifically for use by persons who have received formal training from Coherent, and should not be used by untrained personnel. A Service Manual for the 7970/7901 may be purchased from the Coherent Service Department. It is company policy not to distribute service tools outside of the Coherent Service Organization. Possession of service instructions or tools does not authorize repair or modification of a Coherent instrument by untrained personnel.

1. Install energy monitor in front of laser aperture.
2. Enter diagnostic #14.
3. Press and hold Service switch, then Reset. Release Service switch, then Reset button.
4. Display will prompt "Wheel Limits". Rotate attenuator wheel to both ends.
5. Press Reset.
6. Display will prompt "Zero Wheel". Rotate attenuator wheel until bottom display is .00 ±0.05.
7. Press Reset.

8. Display will prompt "Footswitch Down". Press the Footswitch and record 10 shots from the energy meter.

9. Display will indicate "Ave. energy = XX.XX". Enter the average power from the 10 shots taken in step #8.

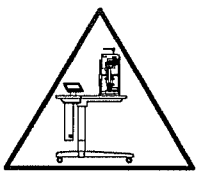
10. Press Reset.

11. Display will prompt "Zero Wheel". Rotate attenuator wheel until bottom display reads .00 ±.05.

12. Repeat steps 7 through 11 eight (8) times.

13. Exit diagnostic routine by pressing Reset button.

14. Verify calibration by taking 10 shots at each setting and compare with the energy meter.



NOTE

Never test the unit past 90 shots at 1pps. If 90 shots have been fired in succession, allow the unit to cool for 20 minutes before taking any additional data.

Troubleshooting Guide

The 7970 Nd:YAG and 7901 Nd:YAG lasers have been subjected to vigorous mechanical and environmental tests. In the unlikely event that the laser fails to operate properly, this troubleshooting guide will help you to locate and correct the malfunction. Should a major malfunction occur, a Coherent Service Representative must be contacted (see Section 7, "Sales and Service Offices").

Before proceeding to the Troubleshooting Guide, check for the following items:

1. System Fuse. Verify that the system fuses are good. (Fuses are located under the table, next to the power plug.)

2. Electrical Power. Verify that the electrical cord is plugged into an appropriate outlet.

3. System Fault Messages.
   a. The first time a fault message is displayed, reset the system as follows. Turn the System Power On/Off key switch counter-clockwise to the Off position, wait 2 seconds, and then turn the key clockwise to the On position.

   b. If the system repeats the SYSTEM FAULT message, even though system can be turned off and on to reset and functions adequately, contact a Coherent Service Representative.

4. SERVICE # Messages.
   a. The first time a SERVICE # message is displayed, reset the system as in #3 above.

   b. If the SERVICE # message is repeated; note the number displayed; call Coherent Service and communicate the number to the Service Representative.

The following conditions require repair by a Coherent Service Representative:

- Low laser energy.
- Repeated system fault messages, even though system can be turned off and on to reset and functions adequately.
- Repeated Interlock fault message on control panel.
- Energy meter out of calibration.
- No laser energy.
- Pulse counter behaves erratically; incorrect count or noise.
- Absence of HeNe laser beam; laser beam is not observed through the oculars.
- Repeated SERVICE # message: call a Coherent Service Representative and give the number displayed.

Message Displayed	Probable Cause	Suggestions
"Beam Blocked" The 7901 Control Panel displays the message "BEAM BLOCKED" and Nd:YAG will function.	Your system uses an LDS-20 Laser Delivery System. The prism head on the LDS-20 is in the beam path.	Move the prism head 10° off-axis. (On all 7901 Nd:YAG's mounted on LDS-20 Laser Delivery Systems, the prism not the head must be moved 10° off-axis to operate.)
"YAG Disabled" The 7901 Control Panel displays the message "YAG DISABLED" and Nd:YAG will not function.	The Remote Interlock Connection is not in place, the interlocked operating room door is open, or... Your system uses an LDS-20 Laser Delivery System and Nd:YAG is not selected.	Plug the Remote Connector into the base of Electronics Module. Close the door. For Nd:YAG operation, depress the Nd:YAG push button. If Nd:YAG is not desired, ignore the message and continued to use argon.
"Footswitch Out"	The Footswitch is not properly plugged into the Electronics Module. With 7921 Combination System, Footswitch is attached to LDS-20 and interconnect cable goes to Electronics Module.	Plug the Footswitch into the bottom of the Electronics Module. On 7921 Combination System, check cables, Footswitch, and Nd:YAG selection.
"Firebutton Out"	Firebutton is the device selected to fire the laser but has been disconnected. **Not** user-accessible.	Install Footswitch; turn system off and then on again. The Footswitch may then be selected.

Difficulty	Probable Cause	Suggestions
Dark Field Of Vision The field of vision is dark as observed through the oculars.	Slit may be closed. Illumination my be reduced. Burned out bulb in slit lamp.	See slit lamp manual for replacement instructions.
Out Of Focus HeNe Laser Beam Laser beam is observed but is out of focus.	Slit lamp binocular eyepieces not properly adjusted.	Adjust Diopter setting on eyepieces.
Distorted HeNe Laser Beam Laser beam is observed and in focus but has a non-circular shape or an ill-defined outline.	Dirty objective lens.	Clean the lens with lens tissue or a cotton swab and methonal.
Laser Beam Will Not Fire When Footswitch Is Depressed	Laser beam will not fire if the Footswitch is depressed before the ready signal.	Wait for ready indicator's audible tone.
Firebutton Will Not Operate	Microprocessor has disabled Firebutton.	Refer to Section 5 "Footswitch ONLY Or Firebutton ONLY Selection" to enable the Firebutton.

Service Error Codes

Should any of the following codes appear on the Control Panel Display, contact Coherent Service at (800) 367-7899.

Service Number	Meaning
1	not used
2	no zero crossing
3	interlock open
4	1 ms timer test failure
5	A/D conversion test failure
6	shutter error
7	footswitch/fire button shorted or held down longer than 1.5 seconds
8	watchdog timer low error
9	watchdog timer high error
10	EPROM checksum errors ROM 0
11	EPROM checksum errors ROM 1
12	zero crossing one shot time
13	H.V. power supply one shot time
14	RAM error
15	EAROM error-not initialized
16	EAROM error-timeout (EAROM stays busy)
17	5 volt supply not 5 volt
18	laser supply not charged or settled
19	watch dog timer timeout
20	high voltage supply pulse not clear
21	missed cycle twice on A.C. zero crossing
22	not used
23	counter no load in 2 tries
24	extra fire error
25	check infrared filter
26	bad code
27	EAROM checksum error
28	laser supply over voltage
29	laser supply not snubbing
30	not used
31	unused NMI detected

Section 7

Customer Service

Warranty Information

Coherent warrants this product to be free from defects in material and workmanship, at the original purchaser's location, for a period of time and under such conditions as specified by Coherent for that product or for 12 months from delivery if a warranty for the individual product is not specified. Any major system manufactured by another firm which has been integrated into a Coherent product is covered by the original manufacturer's warranty.

In order to comply with this warranty, all internal adjustments or modifications must be made by a Coherent certified field engineer or with the expressed permission of Coherent Service Department. Items excluded from this warranty are misuse, negligence, or accidental damage.

The liability of Coherent under valid warranty claims is limited to repair or replacement at Coherent's plant or purchaser's place of business, all at the option of Coherent.

Warranty Shipments, Returns, and Adjustments

A warranty claim must be made promptly and must be received during the applicable warranty period by seller. If it becomes necessary to return a product for repair and/or adjustment, authorization from Coherent must be obtained. Instructions as to how and where these products should be shipped will be provided by Coherent. Any product or component returned for examination and/or warranty repair shall be sent insured prepaid via the means of transportation specified by Coherent. Shipping charges for all products or components replaced or repaired under warranty shall be the sole responsibility of the purchaser.

In all cases, Coherent has sole responsibility for determining the cause and nature of failure, and Coherent's determination with regard thereto will be final.

The foregoing warranty is exclusive and in lieu of all other warranties whether written, or oral or implied, and shall be purchaser's sole remedy and Coherent's sole liability on contract or warranty or otherwise for the product. Coherent disclaims any implied warranty or merchantability or fitness for purposes. In no event shall seller be liable for any incidental or consequential damages arising out of or in connection with the use or performance with the goods delivered hereunder.

Sales and Service Offices

United States

Coherent
3270 West Bayshore Road
Post Office Box 10122
Palo Alto, CA 94303
U.S.A.
Telephone: (415) 858-2250
TWX: 910-373-2023
Fax: (415) 857-0146

For service assistance and to order replacement parts, call Coherent Service at the following nationwide toll free telephone number: (800) 367-7899

To order accessories, call Coherent Sales Administration at one of the following toll free telephone numbers: (800) 227-1914 (outside California) or (800) 227-8450 (inside California).

Europe

Coherent GmbH
Senefelder Strs 10
D-6074 Rodermark 2
Ober-Roden, West Germany
Telephone: 6074-9140
Telex: 4197785
Fax: 6079-5654

Coherent, Ltd.
Cambridge Science Park
Milton Road
Cambridge CB4-4BH
England, UK
Telephone: 223-420501
Telex: 51-817466
Fax: 223-420073

Latin America

Intectra Inc.
2629 Terminal Blvd.
Mountain View, CA 94043
Telephone: (415) 967-8818
Telex: 345545
Fax: (415) 967-8818

Canada

Instrumed Canada
3574 Pitch Pine Cres.
Mississauga, Ontario L5L 1P8
Canada
Telephone: (416) 820-0902
Fax: (416) 820-0902

Asia Pacific

Matsumoto Medical Instruments, Inc.
4-7 Awajimahi Nichome
Chuo-Ku, Osaka 541
Japan
Telephone: 203-7491
Telex: 5222746
Fax: 226-1715

ASR
Antah Sri Radin SDN. BHD.
5, Jalan 51A/241
Petaling Jaya
Malaysia
Telephone: 756-7677
Telex: 37659
Fax: 756-7390

Laser Medical Equipment Co.
315 Outram Road #14-06
Tan Boon Liat Building
Singapore 0316
Telephone: 225-0042
Telex: 29212
Fax: 225-7768

Mediquip, Ltd.
14 SOI 28
Sukumvit 101/1
Bangkok 10260, Thailand
Telephone: 3934100
Telex: 84950
Fax: 3987772

Kuk-Je Medical Co.
63, Nonhyen-Dong
Kangnam-Ku, Seoul
Korea
Telephone: 548-2301
Telex: 28673
Fax: 548-5840

Michev Medical
c/o Post Office
Puhoi, New Zealand
Telephone: 846-20757
Telex: 2553
Fax: 846-20769

Coherent Lasers (Aust.) Pty. Ltd
46 Curtin Avenue
Wahroonga, N.S.W. 2076
Australia
Telephone: 487-3796
Fax: 487-3796

Empire Enterprises Corp.
3 Fl., #51, Sec. 4
Nan King East Road
Taipei, Taiwan
Telephone: 717-1140
Telex: 26965
Fax: 715-5025

Section 8

Errata

Introduction

Section 8 "Errata", is used for retaining records of manual revisions and also provides the opportunity to designate an "Operator Manual Contact" to expedite reception of future manual updates.

Manual Updates

If it becomes necessary for Coherent to update a part of your manual, you will be sent the replacement pages along with a "Errata List." The Errata List will instruct you to remove specific pages from the manual and substitute them with the replacement pages.

You will also be instructed to place the Errata List in this section. This is done as a future reference should a question arise concerning the revision level of your manual.

Operator Manual Contact

This section also contains two identical postage paid (if mailed in the United States) forms. The forms are provided for institutions who wish to designate an individual or department as the "contact" for any future updates regarding this manual. The intent is to deliver the manual updates to the right person/location without delay.

If you wish to specify a contact, please remove one of the "Operator Manual Contact" business reply cards from this section. (A second card is provided should the contact information change at a later date.) Supply all requested information applicable to your situation (please print in ink or type).

On the following pages, space has been provided for duplication of the contact information for your records. This is done as a future reference should a question arise concerning the contact data submitted to Coherent.

After you have mailed and Coherent has received the "Operator Manual Contact" business reply card, your information will be entered into our computerized customer data base. If it becomes necessary for Coherent to update a part of your manual, the update package will be addressed and sent directly to the contact.

Record of Contact Information

The following pages have been provided for duplication of the contact information for your records.

Last Name First Middle Initial

Institution Name (if applicable)

Department Name (if applicable) Mail Stop

Street Address

City State Zip

( )
Telephone

Title of Operator Manual

Last Name First Middle Initial

Institution Name (if applicable)

Department Name (if applicable) Mail Stop

Street Address

City State Zip

( )
Telephone

Title of Operator Manual

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