VANDERBILT UNIVERSITY MEDICAL CENTER

LASER SAFETY PROGRAM

V U M C

Laser Safety Program

2011

Purpose

The purpose of this manual is to provide information to ensure the safe use of lasers at Vanderbilt University Medical Center. To achieve this goal, VUMC has adopted the American National Standard for Safe Use of Lasers, ANSI Z136.3-2005. ANSI Z136.3-2005 is recognized as a minimum standard for laser safety.

Each VUMC department using Class 3b and Class 4 lasers will appoint a laser safety liaison to work with the LSO to fulfill the requirements outlined in this program. All Class 3b and Class 4 laser systems should be registered at the office of the LSO. The LSO will implement the laser safety program of VUMC using available resources and services. Other safety programs outlined in this manual include the following: development of standard operating procedures for these laser installations, and laser safety training for persons working with these systems. The collective efforts of the stakeholders for this program will help accomplish the goal of a safer working environment for the use of lasers.

Scope

This program applies to the ownership, use and operation of lasers 3b and 4 used in operating rooms, clinics, and research at VUMC. Safety guidelines referenced in this program are from the "*Guide for the Safe Use of Lasers*" (ANSI Z136.1 – 2005), published by the American National Standards Institute.

VANDERBILT UNIVERSITY MEDICAL CENTER
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Introduction

The process of stimulated emission makes laser light unique from ordinary light. These unique properties of laser include:

1. Coherent - wave patterns that are locked in phase
2. Collimated – stays together as a tight beam of light
3. Monochromatic – produces pure colors of light

This process of stimulated emission was originally described by Albert Einstein in the 1900s.

The acronym **LASER** stands for **L**ight **A**mplification by **S**timulated **E**mission of **R**adiation defines the process by which a form of energy is converted into a light energy. The emitted radiation produces over a wide range of the electromagnetic spectrum from the ultraviolet region, the visible, and the infrared region. The range is identified by wavelengths from 100 nanometers to 10.6 micrometers. A wave can be characterized by four properties; wavelength, amplitude, velocity, and frequency. Laser beam emission may be delivered as a continuous wave, pulsed, or Q-switched.

There are three broad categories regarding tissue responses to the laser energy – *thermal, mechanical, and chemical*. Most surgical lasers produce thermal effect at the tissue level. This includes the ability of the laser to cut, coagulate, vaporize, and ablate tissues. Some lasers mechanically disrupt tissues by producing sonic (acoustic) energy, like the breaking apart of kidney stones in the ureter. Activating light-sensitive medications to disrupt and change tissue is an example of the chemical effect a laser beam can produce.

The depth of penetration of the laser beam depends on the wavelength, color and consistency of the tissue, power intensity, exposure duration, and spot size.

Accidents are preventable. Identifying risks before they manifests themselves into accidents is the key to implementing any safety programs. Education, training, proactive safety rounding, and the use of safety audit tools will reinforce a culture of safety among stakeholders. This program will review basic laser concepts, non-beam hazards, laser safety, and the roles and responsibilities of the LSO, department laser safety liaison and laser assistants.

Laser System components:

1. Active medium - what makes the laser
2. Excitation mechanism – power supply
3. Feedback mechanism – laser power mirrors
4. Output Coupler – The front, partially transmissive mirror

Active Mediums:

1. Solid – Nd;YAG, Ho:YAG, Er:YAG, Er:Glass, YSGG, Ruby, Alexandrite
2. Gas – CO2, Argon/Krypton, Excimers (excited dimmers - various types), Helium Neon, Copper Bromide (a salt that volatizes into a gas)
3. Liquid – Dyes (various kinds)

4. Electronic – Semiconductors – Diode Lasers

Energy Concepts

Power in WATTS – a measure of the RATE of energy delivered in Joules/second.

$$\text{Watts (W)} = \frac{\text{Joules(J)}}{\text{Seconds (s)}}$$

Power Density – Is the amount of power distributed within the area of the spot. Expressed in watts/cm^2.

$$\text{Power Density} = \frac{\text{Watts}}{\text{Spot size(cm}^2\text{)}}$$

Fluence – An important concept that affects precision during laser surgery. This concept involves three important variable properties – watts, time, and spot size. Utilizing the highest and most appropriate wattage for the shortest time minimizes any damage to adjacent healthy tissues.

$$\text{Fluence} = \frac{\text{Watts x Time}}{\text{Spot size (cm}^2\text{)}}$$

Laser-Tissue Interaction

Four specific interactions can occur when laser energy is delivered to the tissues;

1. Reflection – occurs when the angle of reflection is equal to the angle of the oncoming light.
2. Scattering – Occurs when the laser light energy within the tissue can be altered when the beam is scattered though the tissue.
3. Transmission – Some laser wavelengths can be transmitted through certain tissues or solutions but have little or no thermal effect
4. Absorption – Absorption of laser energy depends on the wavelength and fluence of the beam, tissue color, consistency, and water content.

Tissue Changes With Temperature Increases		
Temperature	**Visual Change**	**Biological Change**
37 -- 60 ^{o} C	No Visual Change	Warming, welding
60 – 65 ^{o} C	Blanching	Coagulation
35 – 90 ^{o} C	White/grey	Protein denaturization
90 – 100 ^{o} C	Puckering	Drying
100 ^{o} C	Smoke plume	Vaporization

Laser Classification

Laser equipment and products containing laser beams must be classified according to the amount of radiation accessible during normal usage. The maximum output energy or power must be considered when determining the laser classification. Laser classification relates to the potential for injury from the beam itself not from related dangers such as electrical systems.

All lasers and laser systems in the U.S. are categorized into one of several hazard classes. Corresponding labels affixed to the laser or laser system positively identify the class. These laser classifications are detailed in ANSI Z136.1, ANSI Z136.3; the Federal Laser Products Performance Standard, 21 CFR 1040.10 and 1040.11; and the International Electrotechnical Commission (IEC).

Class	Characteristic
Class 1	• This class is eye safe under all operating conditions • Do not emit harmful levels of radiation during normal operation. • Also includes higher class lasers completely enclosed and interlocked to prevent beam access, allowing a Class 1 laser system designation; any time the higher class laser is accessible (e.g. during alignment or servicing), the higher laser class controls must be observed. • Can be used without restriction in the manner intended by the manufacturer and without special operator training or qualification.
Class 2	• Emit accessible laser light in the visible wavelength region. • Capable of creating eye damage through chronic exposure. • In general, the human eye will blink within 0.25 second when exposed to Class 2 laser light; this blink reflex provides adequate protection. • Can be used without restriction in the manner intended by the manufacturer and without special operator training or qualification.
Class 3a	• Normally not hazardous when viewed momentarily with the unaided eye, but may pose severe eye hazards when viewed through collecting optics (e.g., microscopes and binoculars). Power levels 1-5 milliwatt (mW). • Same controls as Class 1 and Class 2 lasers for normal operations; if viewed through optical instruments (e.g., binoculars, telescopes, or microscopes), contact the LSO for a hazard review.
Class 3b	• Will cause injury upon direct viewing of the beam and specular reflections. • Power output 5-500 mW for CW or less than 0.03 joule (J) for a pulsed system (i.e. pulse width less than 0.25 second). • The radiation can be a hazard to the eye or skin. However, viewing of the diffuse reflection is safe
Class 4	• Includes all laser systems with power levels greater than 500 mW CW or greater than 0.03 J for a pulsed system. • Pose eye hazards, skin hazards, and fire hazards. Viewing the beam or specular reflections or exposure to diffuse reflections can cause eye and skin injuries. • All control measures explained in this document must be implemented.

COMMON LASER SYSTEM USED IN MEDICAL APPLICATIONS

Carbon Dioxide (CO_2) Laser

Far infrared beam – 10,600 nm
Active Medium: CO_2 gas
Target Organs – cornea of the eye. Skin (thermal burns)
General continuous wave operation, sometimes pulsed
Can be focused to cut tissue, or defocused to ablate or shave tissue
Uses: removal of skin lesions, as laser scalpel, surgery for snoring (rhinophyma), skin shaving/resurfacing, wrinkle removal, cutting/vaporizing tissue, endoscopic surgery, dental treatments.

Argon Laser

Blue-green visible light – (488 nm, 514 nm)
Active Medium: Argon Flouride excimer
Target Organs – retina of the eye. Skin (thermal burns)
Continuous wave or pulsed
Uses: Retinal/ear surgery; port wine birthmark removal, spider vein removal, photodynamic therapy (shrink/dissolve tumors)

Nd:YAG Laser

Near infrared beam – (1064 nm or 1320 nm)
Active Medium: Neodymium:yttrium-aluminum-garnet crystal
Target Organs – retina of the eye. Skin (thermal burns)
Continuous wave or pulsed
Uses: Tattoo removal, hair removal, condyloma acuminate, dentistry, endometrial ablation, heel spurs, hemorrhoids, intravascular sealing, laser angioplasty

KTP/YAG Laser

Green visible light – (532 nm)
Active Medium: Potassium Titanyl Phosphate/ yttrium-aluminum-garnet crystal
Target Organs – retina of the eye. Skin (thermal burns)
Continuous wave or pulsed
Uses: removal of prominent veins, cuts tissue, red/orange tattoo removal, endoscopic surgery, hemorrhoids, keloids, laser discectomy, prostatectomy, podiatric procedures

Erbium YAG Laser

Middle infrared beam – (2940 nm)
Active Medium: Erbium: yttrium-aluminum-garnet crystal
Target Organs – Cornea of the eye. Skin (thermal burns)
Continuous wave or pulsed
Uses: removal of prominent veins, cuts tissue, red/orange tattoo removal, endoscopic surgery, hemorrhoids, keloids, laser discectomy, prostatectomy, podiatric procedures

Holmium:YAG Laser

Middle infrared beam – (2070 nm)
Active Medium: Holmium: yttrium-aluminum-garnet crystal
Target Organs – Cornea of the eye. Skin (thermal burns)
Generally pulsed
Uses: Urological procedures, orthopedic, ENT, oral and laryngeal procedures, dental applications, ablate bone and cartilage

Ruby Laser

Red visible beam – (694 nm)
Active Medium: Cr3+:Al203
Target Organs – retina of the eye. Skin (thermal burns)
Pulsed
Uses: Tattoo and pigmented lesion removal, hair removal

Alexandrite Laser

Red visible beam – (755 nm)
Active Medium: Alexandrite crystal
Target Organs – Retina of the eye. Skin (thermal burns)
Pulsed
Uses: Tattoo and hair removal

Pulsed Dye Laser

Yellow visible beam – (577 nm, 585 nm)
Active Medium: Dye
Target Organs – Retina of the eye. Skin (thermal burns)
Pulsed
Uses: Port wine stain and scar removal, and vascular lesion treatments (facial spider veins, Rosacea)

Copper Vapor Laser

Green visible beam – (511 nm, 577 nm)
Active Medium: Cu ions
Target Organs – Retina of the eye. Skin (thermal burns)
Pulsed
Uses: Vascular lesion treatments, epidermal pigmented lesions

Diode Laser

Near-infrared beam – (800-900 nm)
Active Medium: Diode
Target Organs – Retina of the eye. Skin (thermal burns)
Pulsed or continuous
Uses: hair removal, periodontal surgery, superficial vein removal

Excimer Laser

Near-infrared beam – (193 – 351 nm)
Active Medium: Inert gas
Target Organs – Cornea/lens of eye. Skin (photochemical burns)
Pulsed
Uses: LASIK (Laser-Assisted in Situ Keratomileusis), eye surgeries

Flexible Lasers/Flexible Delivery Systems

Personnel handling laser fibers/flexible laser delivery system will assure and observe safety compliance in all procedures and will treat the fiber as an extension of the laser system, governed by applicable standards, policies, and regulations.

1. Fibers and associated equipment will be positioned to allow for safe traffic patterns in the treatment room.
2. Laser fibers should be examined for breaks or damage on the distal tip, the proximal connector, and the catheter sheath.
3. Laser fibers should be calibrated in accordance with manufacturer's directions.
4. Fibers that are damaged and found to be deficient should be replaced with another fiber.
5. Clamps or other instruments should not be used to secure laser fibers in the operative site.
6. Lasers should never be operated unless the aiming beam is visible and the tip of the fiber is beyond the end of the endoscope.
7. Laser fiber should be monitored for beam distortion, decreased power transmission, and accumulation of debris on the distal tip.
8. Disposable laser fibers should not be reused.
9. Lasers should be on standby mode when not aimed at a target.

Non-Beam Hazards

The LSO shall effect necessary evaluations and control methods to address diversity of potential laser hazards.

1. Electrical Hazards

   Electrical cords should be inspected for damage before plugging the laser unit to the power outlet. Solution bottles and bowls should not be placed on top of the laser unit because any spillage or splatter could cause internal short circuiting within the laser. Protective housing of the laser unit should never be opened or removed by unauthorized staff. Laser foot pedals should be kept dry from irrigations and other solutions used during the laser procedure.

   Some lasers units use high-voltage power supplies, large capacitors, or capacitor banks that present a lethal shock hazard. Electrical safety controls include:

   a) OSHA [29 CFR 1910 S] requires additional controls and training for work on live circuits operating a more than 50 volts; Capacitors maintain a lethal charge even if the equipment is de-energized and unplugged. Observe extreme caution when servicing laser equipment.
   b) Check laser unit for frayed wires and ensure that electrical terminals are covered.
   c) Only use laser unit with current preventive maintenance tags or stickers.

d) Use specified power outlets for specific laser unit or per manufacturer recommendations
e) Use equipment only for its intended/designed purpose.

Good judgment and generally recognized electrical precautions should be observed around all laser equipment.

2. Laser Generated Airborne Contaminants (LGAC)

Laser Generated Airborne Contaminant can contain blood, blood by-products and pathogens. Laser procedures that produce plume shall use control measures such as portable smoke evacuators or the local exhaust ventilation. Laser plume is a health hazard. Irritation by laser plume can cause burning, watery eyes, nausea and vomiting, and headaches.

As the plume wand is held within 1 cm of the laser impact site, approximately 98% of the smoke is eliminated. As the wand is held 2 cm away, the evacuation of the plume is decreases to 51%. (*Milhashi S et al: Some problems about condensates induced by CO2 laser irradiation, Department of Otolaryngology and public health, 1975b, Karume university)*

3. Fire

- Dry combustibles should never be placed in the immediate vicinity of the laser target area. Potentially flammable items, such as towels, sponges, gauge pads, and swabs should be wet so that ignition cannot occur. Use fire-retardant drapes, damp pack or pads.
- Never use alcohol or flammable agents in the operating field.
- Fibers may be rinsed in hydrogen peroxide, water, or saline intraoperatively.
- Never place a hot fiber directly on dry drapes. Wait until tip is cool before contact is made with flammable materials
- Put laser system on standby mode when procedure is interrupted or terminated
- Avoid high levels of oxygen in the operative field.
- Avoid laser beam exposure of the sheaths of flexible fiber endoscopes.
- Use laser wavelength specific endo-tracheal tubes for laser procedures involving the respiratory tract.

Steps to be taken if an ET tube fire occurs:
• Remove the flaming ET tube and instruments
• Dispose flaming ET tube to a bucket of water
• Stop flow of oxygen by pinching the oxygen tube or shutting off the supply valve
• Reintubate immediately to prevent laryngospasm
• Inspect the mouth, oral cavity, and bronchial tree.

4. Compressed Gases and Cryogenics

   Hazardous gases may be used in laser applications; i.e. excimer lasers (fluorine, hydrogenchloride). Cryogenic fluids are used in cooling systems of some lasers. The SOP should contain references for the safe handling of compressed gases. Refer to MSDS for detailed information on the safe handling on the specific compressed gas and/or cryogenic used with the laser unit.

5. Dyes

   Dyes used as the optically active medium in some laser units are toxic and/or carcinogenic chemicals dissolved in flammable solvents. This creates the potential for personnel exposures above permissible limits, fires, and chemical spills. Refer to MSDS for detailed information on the safe handling on the specific dyes used with the laser unit.

6. UV and Visible Radiation

   Maintaining the integrity of the laser housing and avoid operating any laser unit without the protective housing will provide protection from UV and visible radiation that pose eye and skin hazards.

Safety Requirements

1. Nominal Hazard Zone

   "The space within which level of the direct, reflected or scattered radiation during normal operation exceeds the applicable Maximum Permissible Exposure (MPE)." *Guide for the Safe Use of Lasers*" (ANSI Z136.1 – 2005),

   Nominal Hazard Zone can be calculated using a laser range equation that take into account the laser wavelength, beam divergence, laser power, beam size at the aperture and/or lens, lens focal length, and range from the laser to the target. The NHZs vary depending on the wavelengths that are delivered through fibers. To simply this situation, NHZ is considered to be within the treatment area or the surgery room.

2. Maximum Permissible Exposure

   "is the level of laser radiation to which a person may be exposed without hazardous effects or adverse biological changes in the eye or skin" *Guide for the Safe Use of Lasers*" (ANSI Z136.1 – 2005),

3. Eye Protection

   Implementing eye safety measures is of paramount importance during laser procedures. MAXIMUM measures should be implemented to provide OPTIMUM eye protection. Eye damage depends on the laser wavelength. Even low levels of laser radiation can cause permanent eye damage.

   Patient's eyes should be protected at all times during laser procedures. Eye protection

may include but not limited to laser safety eyewear, wet eye pads, protective metal eye shields, wet towels, wet drapes as deemed appropriate.

Prescription glasses are not recommended as appropriate protection because the glass or plastic material may not absorb the laser beam adequately, and subsequent transmission of the beam to the eyes could occur.

Contact lenses do not protect part of the eye which is the sclera, thereby rendering insufficient protection for the eyes.

"The use of laser protective eyewear is mandatory with Class IV lasers. Protective eyewear shall be fabricated of plastic or glass absorption filters appropriate for the laser. All laser protective eyewear shall be clearly labeled with optical density values and wavelengths for which protection is afforded." *STD 01-05-001 - PUB 8-1.7 – Guidelines for Laser Safety and Hazard Assessment, OSHA Directive*

Per OSHA, "LASER EYEWEAR MUST BE ON BEFORE THE LASER CAN BE TURNED ON" *STD 01-05-001 - PUB 8-1.7 – Guidelines for Laser Safety and Hazard Assessment, OSHA Directive*

For best and safe practices, laser eye protection should always be used in case unexpected or unusual events occur that could cause eye damage.

4. Fire Extinguishers

Characteristics of each fire extinguisher should be considered proactively when dealing with fire safety. Laser users or personnel charged to operate the laser unit should be aware of the location of the closest available fire extinguisher.

There several types of fire extinguisher. Each type has different characteristics.

Fire Extinguisher	Characteristics
Halon	Consists of hydrogen halocarbons. Does not produce a residue and has low toxicity. Disrupts ozone layer.
Halon (environment-friendly)	Same characteristic as above but doe not disrupt ozone layer.
Dry Chemical	Emits fine dust that could damage the optics and circuitry of the laser equipment.
CO2	Pressurized content are extremely cold when discharged. Can cause cryogenic tissue damage on the patient. Residue will coat inner parts of the laser and can cause tube fracture and damage other component of the laser.
Water	Can provide path for electrical energy which leads to potential injury or death to anyone in contact with the water.

5. Endotracheal Tube

   Unprotected polyvinyl chloride (PVC) ET tube must never be used during oral or laryngeal laser surgeries. PVC ET tubes can be ignited by a laser beam and will support combustion. PVC ET tubes are extremely flammable. ET tubes made specifically for laser procedures are available for use for specific wavelengths, examples are Laser Tube (Rusch), Laser-Flex (Mallinckridt), Laser-Shield (Medtronics). Follow manufacturer's recommendations on the safe use of these products.

   Laser resistant endotracheal tubes approved by FDA shall be inflated with fluid or per manufacturer's recommendation and externally protected with wet cottonoids. Lowest concentration of oxygen shall be used in laryngeo-tracheal procedures.

   Emergency Tracheotomy kit/tray will be made available in all laser airway cases for use in the event of an emergency. The kit need not be opened unless it is required.

6. Water

   A container of water should be kept readily available during all laser procedures for immediate dousing of fire if needed.

7. Masks

   High-filtration masks with a filtering capacity of particulate matter 0.1 µm in size should be worn by surgical team members during any procedure that generate plume.

   To decrease the chance of inhaling hazardous matter, masks should be worn properly, covering the nose and mouth. The sides of the mask should conform to the face adequately.

8. Display of Warming Signs

   Specific laser warning signs shall be conspicuously displayed on ALL doors leading to the laser treatment area. Warning signs should be covered, switched off, or removed when the laser is not in use.

9. Laser Keys

   For laser systems equipped with a key switch to prevent unauthorized use, the key must not be left in the switch when the laser system is unattended. Keys should be kept in a specified area.

10. Other safety measures:

    - Solution bottles should never be placed on top of the laser unit to prevent spillage or splatter on the internal circuitry of the laser unit.
    - Foot pedals should be kept dry and protected from water or other fluids.
    - Protective covering of laser units should never be removed by unauthorized personnel because of the risk of electric shock and electrocution.
    - Laser unit should be at least 12 inches away from walls to allow air to circulate

and cool the internal system during laser operation.

- When transporting laser units, care must be taken to prevent the unit from being jarred or hit solid objects that may cause damage to laser components.

Laser System Maintenance and Servicing

Maintenance and service inspection shall be performed by qualified personnel. Qualified service personnel may include:

- Manufacturer's service technicians
- Third party service agents
- VUMC biomedical engineers

Service personnel shall have documented laser safety training, and documented service training commensurate with the level of work they are performing on the laser

Periodic maintenance, including calibration checks, shall be performed at scheduled intervals. Written service report shall be maintained by the Laser Safety Officer and/or at VUMC biomedical engineering department.

Use of Loaner Laser Equipment and Safety Accessories

Laser equipment under contract for use at VUMC should be inspected by VUMC biomedical engineering. Biomed inspection tags should be current and placed on the laser equipment. Preventive maintenance tags should be also current.

Laser safety accessories should be provided by the loaner company laser technician per laser procedure. Other safety requirements should be observed and implemented by the loaner company personnel.

Laser Registration

All Class 3b and Class 4 lasers will be registered with the Laser Safety Officer. The process is initiated by completing the laser registration form found in **Appendix A.** The registration will include standard operating procedures including necessary safety requirements, for all Class 3b and Class 4 lasers. Upon receipt of the completed registration form, the LSO will conduct a laser safety inspection.

Laser Safety Audit

Periodic laser safety audits shall be performed on scheduled intervals. Audits are performed by the department laser safety liaison and/or the LSO. See Appendix

Laser Safety Training/Credentialing

1. Laser safety training shall be incorporated into employee orientation training. Sign-in sheets for laser in services will be acceptable documentation of such training that includes laser safety.

2. Credentialing of such assistants is through approval of the Laser Safety Officer (LSO). Laser assistants may be RNs, LPNs, PAs, Surgical Technicians (ORTA/CST), other individuals deemed qualified by the LSO.

3. The LSO shall maintain a current list of credentialed Laser Assistants with Patient Care Managers for the purpose of coordinating schedules for laser cases.

4. Laser safety training may be obtained from the manufacturer or another credentialed laser assistant or the LSO, formalized courses, or individualized study.

5. Another credentialed assistant, or the Laser Safety Officer, shall be present for the first two assisted laser procedures.

6. Once an initial approval for one laser type is granted, approval for the additional types of lasers may be obtained by incremental instruction in the operation of the additional laser system/s as determined by the LSO.

7. Content of the laser safety training should emphasize understanding of operational characteristics of the equipment, biologic and physical properties of the laser tissue interaction, potential hazards associated with laser use, procedures and equipment required to ensure a safe laser environment.

8. Skills validation for Laser Assistants are performed annually by the department Laser Safety Liaison and/or the LSO.

Table: Laser Safety Training Components

	Training Component	MD	RN	Tech	Service	LSO
1	Laser Biophysics/Biological Effects	X	X	X		X
2	System Components/Delivery Devices/Instrumentation	X	X	X	X	X
3	Federal, State, Local Regulations	X	X	X	X	X
4	ANSI Z136.1 Z136.3 Standards	X	X	X	X	X
5	Institutional Policy/Procedures	X	X	X	X	X
6	Hazard Classification				X	X
7	Access to Laser Key		X			X
8	Documentation/Incident Reporting	X	X			X
9	Anesthesia Hazards	X	X	X		X
10	Personal Protective Equipment	X	X	X	X	X
11	Patient Protection	X	X	X		X
12	Operational Skills Workshops	X	X	X	X	X
13	Procedure for Safety Audits					X

Documentation

All registered laser systems should have a copy of the SOP or operating manual. Laser logs should be kept with laser unit. Pertinent laser procedure information, and laser dosimetry should be written on the laser log.

The LSO may change, add or eliminate information on the laser log as deem appropriate. The use of a laser log does not preclude or replace the need for patient charting as required by law, and policy.

Laser Safety/Operational Checklists

An abbreviated checklist for proper laser setup, operation and safety shall be utilized by the dedicated laser assistant for each laser case. The checklist shall be determined by the LSO, and may be altered by the LSO as deemed necessary.

Responsibilities

Laser Safety Officer (Program Manager, Laser Safety)

1. Review, recommend, coordinate, and assist with laser system evaluations on the purchase of Class 3b and Class 4 laser systems.
2. Provide assistance in evaluating, assessing and controlling hazards.
3. Active member of Laser Safety Committee
4. Maintain records of laser systems, laser safety liaison, and laser assistants.
5. Coordinate/conduct laser safety training.
6. Participate in accident investigations involving lasers.
7. Periodically audit the departmental Laser Safety Program.
8. Perform laser safety audits on scheduled intervals or more frequent as deemed necessary.
9. Ensure that proper safety and operational training is provided to the Laser Safety Liaison, Laser Assistants.
10. Work collaboratively with hospital physician credentialing mechanism to ensure that physicians are properly credentialed for specific laser systems.
11. The LSO shall ensure that a written Standard Operating Procedure (SOP) plan is developed. The plan will describe the intended use of the laser device, its associated safety features and the procedures to assure the safety to laser operators and other persons in the vicinity of the laser device. The SOP must also include the names of all laser operators.
12. Ensure that laser rental company or any similar contract laser service that operate within the facility has supplied the LSO evidence or documentation of appropriate training of the rental company's laser technicians and periodic maintenance of their equipment.
13. Conduct comprehensive Laser Safety Audit/Inspection of the facility's laser safety program, protective safety equipment and accessories.
14. Become a member of American Society for Laser Medicine and Society (ASLMS), in order to stay abreast of developments in the medical laser field, and disseminate such information to hospital physician staff as deemed appropriate.

15. Maintain continuing education on an annual basis in the area of medical/surgical laser use or safety.

Department

Identify laser products that are covered by the ANSI Standard Z136.3 – 2005 and establish procedures to ensure that the ANSI standards, VUMC laser safety policies, a are followed.

Ensure individual who work with or around lasers have received the proper laser safety training.

Establish a safety review procedure to determine that adequate hazard analyses and corrective actions have been completed for all applicable laser systems.

Laser Safety Liaison

1. Be knowledgeable of the education and training requirements for laser safety, the potential laser hazards and associated control measures for all lasers under their control
2. Report known or suspected accidents to VEHS and Laser Safety Officer.
3. Ensure that lasers under their control are not operated or modified without approval from the LSO, supervisor or principal investigator.
4. Ensure that all administrative and engineering controls are followed.
5. Maintain inventory control and a permanent record of the status of all Class 3B, and Class 4 lasers
6. Ensure that individuals working with lasers have attended and taken the general laser safety training and provide laser operators with training in the administrative, safety and standard operating procedures.
7. Classify and label any unclassified lasers
8. Attend scheduled VUMC laser safety training programs.
9. Notify VEHS immediately in the event of an exposure to a Class 3 or Class 4 laser.
10. Report known or suspected accidents to VEHS and Laser Safety Officer.
11. Provide standard operating procedures (SOP), in accordance with ANSI Z136.1-2005 and any established VUMC policy, for all laser operations involving Class 3 and Class 4 lasers detailing alignment, operation and maintenance procedures.

Laser Assistants

1. Laser assistants shall be assigned to set up and operate the laser equipment, and monitor the laser treatment controlled area for safety during laser procedures. From the time the laser switch is activated, to the time it is turned off, the laser assistant shall control the operating panel and monitor room for compliance with safety policies and procedures.
2. Attend laser safety training.
3. Familiar with laser wavelength specific safety hazards and non-beam hazards
4. Follow standard operating procedures and comply with requirements established by the Laser Safety Committee, and VUMC policies.
5. Report known or suspected accidents to the supervisor, EHS, and the LSO.
6. Committed to implement laser safety standards and policies.

Laser Acquisition, Transfer, and Disposal

Notify the LSO of any decision to purchase laser equipment or otherwise acquire a Class 3b or Class 4 laser. The LSO will review with the user the hazards of the proposed operation and make recommendations regarding the specific safety requirements that pertain to the proposed use, including requirements for SOPs, laser control areas, training, and personnel protective equipment.

Also notify the LSO of any class 3b or 4 laser or laser system being relocated, transferred to another department, or sent offsite as surplus equipment. Departments have an obligation to ensure safe and responsible disposition of their unneeded, but potentially hazardous, class 3b or 4 lasers and laser components. Appropriate means of laser disposal include:

- Donate the laser to an organization (e.g. school, industrial company, hospital) with a need for such a device. The donor should ensure that the donated laser system complies with all applicable product safety standards, such as the Federal Laser Product Performance Standard, and is provided with adequate safety instructions for operations and maintenance. The donor should also verify that the receiving organization has a viable laser safety program.
- Return the laser to the manufacturer, or to a vendor specializing in re-selling used laser equipment or components.
- Eliminate the possibility of activating the laser by removing all means by which it can be electrically activated. Once this has happened the laser could then be discarded.
- Destroy the laser.

The last two methods also require proper disposal of any hazardous materials found inside the laser components, such as mercury switches, oils, dyes, etc. Users should contact the LSO if they need further information or assistance with proper disposal.

Physician Laser Credentialing

Refer to VUMC Laser: Physician Guidelines for Using Lasers, CL 30-02.05. See flow chart end of page.

Accident Reporting

The LSO shall be responsible for notifying the Office of Risk Management within 24 hours of any accident involving a laser device. Lasers involved in an accident shall be taken out of service immediately. The LSO and Office of Risk Management shall be responsible for evaluating the accident and the safety of the laser device.

Information and Education links

VUnet ID required for this laser safety module

http://www.safety.vanderbilt.edu/training/topics_laser.htm

http://www.safety.vanderbilt.edu/safety_links/laser.htm

Laser Related VUMC Policies

Policy	No.
Candela Vbeam Laser: Use of	CL 30-00.09
CO2 Xanar Laser: Use of	CL 30-00.02
Coherent Aura Nd: Yag Laser: Use of	CL 30-00.11
Coherent Novus Omni and Novus 2000 Argon Lasers: Use of	CL 30-00.12
Coherent OPAL Photoactivator PFT Lasers: Use of	CL 30-00.10
Lasers: Physician Guidelines for Using Lasers	CL 30-02.05
Lasers: Protocol for Patients Undergoing Laser Surgery	CL 30-02.06
Lasers: Safe Use within the Clinical Setting	CL 30-04.21
Laserscope (Lasersonics) Nd:YAG Laser:Use of	CL 30-00.06
Laserscope KTP/Nd:YAG Laser	CL 30-00.07
Sharplan CO2 Lasers	CL 30-00.08

References

1. ANSI, Z136.3-2005, *American National Standard for Safe Use of Lasers in Health Care Facilities, 2005, Orlando, FL, Laser Institute of America*
2. Kay Ball, *Lasers: The Perioperative Challenge, 3rd ed., St. Louis, 2004, Mosby-Yearbook.*
3. Lasers: Protocol for Patients Undergoing Laser Surgery, VUMC Policy, CL 30-02.06

ENDOTRACHEAL TUBE INFORMATION

Laser-Sheild II (Medtronic) – For CO2 (10,600 nm) and KTP (532 nm)				
Size (FR)	**ID mm**	**OD mm**	**Reference No.**	**Item No. (VUMC)**
24	5	8	7060200	4146
27	6	9	7060300	8093
31	7	10.5	7060400	8094

WARNING:
- Do not use with Nd:YAG laser or argon laser, or ANY TYPE other than CO2 or KTP.
- Do not use nitrous oxide for dilution of oxygen
- Don not over-inflate the cuff. Over inflation may result in tracheal damage

Recommendation: Use 30% oxygen / 70% helium, or 30% oxygen / 70% room air

Laser Tube (Rusch) – with LATEX				
ID mm	**OD mm**	**Balloon OD mm**	**Reference No.**	**Item No. (VUMC)**
8	13.5 (nominal) – 13.7	27	102004	29323

WARNING:
- Ensure that the surface of the Laser-Guard foil always remains moist during surgery.
- Please frequently check during the operation whether the surface of the Laser-Guard foil is still sufficiently moist. If necessary moist it again.
- Check the tube at short intervals for any damages while it is being used.
- Increased caution must be exercised when using oxygen and laser.

Laser Resistance of the Tracheal Tube		
Laser System	**Power (W)**	**Laser Energy Duration**
Nd:YAG	100	5 sec
CO2, CW	40	120 sec
Ar	25	120
CO2, SP	15	120
Nd:YAG, 2f	5	120

Laser Flex (Mallinckrodt) – Proven on CO2 and KTP				
Size (FR)	**ID mm**	**OD mm**	**Reference No.**	**Item No. (VUMC)**
	4.5	7	86397	19656

INDICATION:
- Laser surgery of the larynx and other areas in close proximity to the tracheal tube using CO2 or KTP laser beam.

DESCRIPTION:
- Stainless steel body is airtight
- Proven resistant to CO2 and KTP lasers.
- Reflected laser beams are defocused, reducing damage to surrounding healthy tissue

Dilute oxygen or other flammable gases with helium, nitrogen or room air as needed. Dilute oxygen to the minimal inspired concentration compatible with satisfactory oxygen saturation.

NOTE: Information purposes only. Not intended for product endorsement.

VUMC
Laser Safety Program

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