VANDERBILT UNIVERSITY
MEDICAL CENTER

LASER SAFETY PROGRAM

2018
Purpose

The purpose of this manual is to provide information to ensure the safe use of lasers at Vanderbilt University Medical Center (VUMC). To achieve this goal, VUMC has adopted the American National Standard for Safe Use of Lasers, ANSI Z136.3-2011. ANSI Z136.3-2011 is recognized as a minimum standard for laser safety.

Each VUMC department using Class 3b and Class 4 lasers will designate a laser safety liaison to work with the MLSO to fulfill the requirements outlined in this program. All Class 3b and Class 4 laser systems should be registered with the Clinical Engineering Department. The MLSO 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 procedural areas at VUMC. Safety guidelines referenced in this program are from the “Guide for the Safe Use of Lasers in Healthcare” (ANSI Z136.1 – 2011), published by the American National Standards Institute.

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What is LASER?

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 Light Amplification by Stimulated Emission of Radiation 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 manifest 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 MLSO, 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,
2. Gas – CO2, Excimers (excited dimmers - various types), Helium Neon, Liquid – Dyes (various kinds)
3. 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/cm².

\[
\text{Power Density} = \frac{\text{Watts}}{\text{Spot size (cm²)}}
\]

*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.

\[
\text{Fluence} = \frac{\text{Watts} \times \text{Time}}{\text{Spot size (cm²)}}
\]

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

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Visual Change</th>
<th>Biological Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>37 – 60 °C</td>
<td>No Visual Change</td>
<td>Warming, welding</td>
</tr>
<tr>
<td>60 – 65 °C</td>
<td>Blanching</td>
<td>Coagulation</td>
</tr>
<tr>
<td>35 – 90 °C</td>
<td>White/grey</td>
<td>Protein denaturization</td>
</tr>
<tr>
<td>90 – 100 °C</td>
<td>Puckering</td>
<td>Drying</td>
</tr>
<tr>
<td>100 °C</td>
<td>Smoke plume</td>
<td>Vaporization</td>
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</tbody>
</table>
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).

<table>
<thead>
<tr>
<th>Class</th>
<th>Characteristic</th>
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<tbody>
<tr>
<td>Class 1</td>
<td>• This class is eye safe under all operating conditions&lt;br&gt;• Do not emit harmful levels of radiation during normal operation. &lt;br&gt;• 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. &lt;br&gt;• Can be used without restriction in the manner intended by the manufacturer and without special operator training or qualification.</td>
</tr>
<tr>
<td>Class 2</td>
<td>• Emit accessible laser light in the visible wavelength region. &lt;br&gt;• Capable of creating eye damage through chronic exposure. &lt;br&gt;• In general, the human eye will blink within 0.25 second when exposed to Class 2 laser light; this blink reflex provides adequate protection. &lt;br&gt;• Can be used without restriction in the manner intended by the manufacturer and without special operator training or qualification.</td>
</tr>
<tr>
<td>Class 3a</td>
<td>• 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). &lt;br&gt;• 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 MLSO for a hazard review.</td>
</tr>
<tr>
<td>Class 3b</td>
<td>• Will cause injury upon direct viewing of the beam and specular reflections. &lt;br&gt;• 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). &lt;br&gt;• The radiation can be a hazard to the eye or skin. However, viewing of the diffuse reflection is safe</td>
</tr>
<tr>
<td>Class 4</td>
<td>• Includes all laser systems with power levels greater than 500 mW CW or greater than 0.03 J for a pulsed system. &lt;br&gt;• 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. &lt;br&gt;• All control measures explained in this document must be implemented.</td>
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</table>
COMMON LASER SYSTEMS USED IN MEDICAL APPLICATIONS

**Carbon Dioxide (CO2) Laser**
- Far infrared beam – 10,600 nm
- Active Medium: CO2 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.*

**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*

**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*

**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)*

**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 Fibers and 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 MLSO 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 laser equipment for its intended use per manufacturer IFU.

**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 use gas to purge laser fiber in the intrauterine cavity.
- 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.

Ways to Fight Airway Fires

1a **STOP THE GAS LOW**
   - Disconnect the breathing circuit – this is the quickest way to stop the gas flow.

1b **REMOVE THE TUBE FROM THE PATIENT**
   - Maintain airway patency

2 **EXTINGUISH THE FIRE**
   - Operating Room personnel other the anesthesiologist/anesthetist should extinguish the smoldering tube.
   - Remove segments of burned tube that may remain in the airway.

3 **CARE OF THE PATIENT**
   - Reestablish the airway and resume ventilating with air until certain that nothing is left burning in the airway; then switch to 100% O2.

**NOTE:** Step 1a and 1b should be done as quickly and simultaneously as possible

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. Refer to the SDS Sheet 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 the SDS sheet 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 – 2014).

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 laser treatment care area or the laser procedure 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 in Healthcare* (ANSI Z136.1 – 2014),

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 3B and 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.” ANSI Z136.3-2014/ OSHA 29 CFR 1926.102(b)(2).

In the United States, several organizations concern themselves with laser safety. These organizations include the American National Standards Institute (ANSI); the Center for Devices and Radiological Health (CDRH) of the Food and Drug Administration (FDA); and the Department of Labor’s Occupational Safety and Health Administration (OSHA).

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.

<table>
<thead>
<tr>
<th>Fire Extinguisher</th>
<th>Characteristics</th>
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</thead>
<tbody>
<tr>
<td>Halon</td>
<td>Consists of hydrogen halocarbons. Does not produce a residue and has low toxicity. Disrupts ozone layer.</td>
</tr>
<tr>
<td>Halon (environment-friendly)</td>
<td>Same characteristic as above but does not disrupt ozone layer.</td>
</tr>
<tr>
<td>Dry Chemical</td>
<td>Emits fine dust that could damage the optics and circuitry of the laser equipment.</td>
</tr>
<tr>
<td>CO2</td>
<td>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.</td>
</tr>
<tr>
<td>Water</td>
<td>Can provide path for electrical energy which leads to potential injury or death to anyone in contact with the water.</td>
</tr>
</tbody>
</table>

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.

FDA-approved laser resistant endotracheal tubes shall be inflated with fluid or per
manufacturer’s recommendation and externally protected with wet cottonoids or gauze. Lowest concentration of oxygen shall be used in laryngo-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 water source should be readily available during all laser procedures for immediate dousing of fire if needed.

7. Smoke/Plume Evacuation

Follow manufacturer instruction and recommendation on the use of smoke evacuation systems, in-line filters, laparoscopic filtering devices, and routine system maintenance.

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

Respiratory protection that is at least as protective as a fit-tested surgical N95 filtering face piece respirator should be used in conjunction with LEV (local exhaust unit) in disease transmissible cases (eg, human papillomavirus) and during high-risk or aerosol transmissible disease procedures (eg, tuberculosis).

Used smoke evacuation tubing, filters, and absorbers are considered infectious waste. Use standard precautions when changing or disposing of used smoke evacuation equipment.

8. Display of Lasers Warning Signs

Wavelength-specific laser warning signs shall be conspicuously displayed on ALL doors leading to the laser treatment care 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 designated secure area.

10. Manufacturer Instruction for Use/Manual

Manufacturer IFU (Instruction for Use) should be followed on the use and operation of laser equipment, maintenance, installation, use of laser accessories, required training, and device reprocessing instructions.

Laser Manuals are available for review on the perioperative website.

11. 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 designated clinical 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. Service reports shall be maintained on Aramark iDESK ECN Inventory.

Laser equipment under contract for use at VUMC shall be inspected by clinical engineering. PM and inspection tags should be current and placed on the laser equipment.

Laser safety accessories should be provided by the loaner company laser technician per laser procedure. Laser safety compliance requirements shall implemented by the loaner company personnel.

**Laser Registration**

All VUMC Class 3b and Class 4 lasers will be registered with the MLSO.

**Laser Safety Implementation**

Periodic laser safety audits shall be performed scheduled intervals. Audits may be also be performed by the department laser safety liaison and/or the MLSO.

**Laser Safety Training**

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

2. Laser safety training may be obtained from the manufacturer, department laser super-
user, department-designated Laser Safety Liaison, or the MLSO.

3. 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.

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

Table: Laser Safety Training Components

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

Documentation

Laser logs should be kept with laser unit. Pertinent laser procedure information, and laser dosimetry should be written on the laser log.

The MLSO 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 MLSO, and may be altered by the MLSO as deemed necessary.
Responsibilities

Medical Laser Safety Officer (Program Manager, Laser Safety)

1. Develops, implements, evaluates and revises programs, of in-service training, continuing education and workshops related to lasers and laser safety for all staff using lasers throughout the clinical enterprise.
2. Maintains a comprehensive program for the safe use of lasers throughout the medical center in accordance with regulatory agencies and currently recognized standards of patient care.
3. Facilitate the maintenance/repairs of lasers and laser related equipment throughout the medical center.
4. Coordinates, implements and completes product/equipment/service evaluations for the medical center, as needed.
5. Recognizes the need for and maintenance of new and existing equipment preventative maintenance contracts for the medical center.
6. Review, recommend, coordinate, and assist with laser system evaluations on the purchase of Class 3b and Class 4 laser systems.
7. Provide assistance in evaluating, assessing and controlling hazards.
8. Active member of Laser Safety Committee
9. Develop, coordinate, and conduct laser safety training.
10. Participate in accident investigations involving lasers.
11. Periodically audit the departmental Laser Safety Program.
12. Perform laser safety audits on scheduled intervals or more frequent as deemed necessary.
13. Ensure that proper safety and operational training is provided to the Laser Safety Liaison, Laser Assistants.
14. Work collaboratively with hospital physician credentialing mechanism to ensure that physicians are properly credentialed for specific laser systems.
15. Ensure that laser rental companies or any similar contracted laser services that operate within the facility has supplied the MLSO evidence or documentation of appropriate training of the rental company’s laser technicians and periodic maintenance of their equipment.
17. Maintain active membership with professional laser societies (e.g., 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 providers as deemed appropriate.
18. Maintain continuing education on an annual basis in the area of medical/surgical laser use or safety.
Laser Safety Liaison

Each VUMC department/pod/clinic will designate a Laser Safety Liaison to help implement with the Laser Safety Program compliance requirements for laser safety. The department will complete a letter of support to this designated role. Designated LSL shall complete the required laser safety training. The following functions of the designated LSL are:

1. Be knowledgeable of the education and training requirements for laser safety, the potential laser hazards and associated safety and quality requirements for all lasers used in the department.
2. Report known or suspected incidents/accidents to VEHS, Occupational Heath, and Laser Safety Officer.
3. Ensure that lasers are not operated or modified without approval from the MLSO, supervisor, Clinical Engineering, or principal investigator.
4. Ensure that all administrative and engineering controls are implemented.
5. Maintain inventory control and a permanent record of the status of all Class 3B, and Class 4 lasers and laser accessories.
6. Ensure that all dept/pod/clinic staff working with lasers have completed the required training and maintained competency on basic laser safety.
7. Attend and completed scheduled VUMC laser safety training programs.
8. Submit required laser safety compliance reports on determined frequencies.

Laser Assistants

1. Laser assistants will be responsible 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 scheduled or required 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, LSL, and the MLSO.
6. Committed to implement laser safety standards and policies.
Laser Acquisition, Transfer, and Disposal

Notify the MLSO of any decision to purchase laser equipment or otherwise acquire a Class 3b or Class 4 laser. The MLSO 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 MLSO 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 MLSO if they need further information or assistance with proper disposal.

Loaner Laser Request and Booking

- TO BOOK A LOANER LASER CALL FORTEC AT 1866-355-8517 or book online.
- ASK FOR A CONFIRMATION NUMBER.

Physician Laser Credentialing

Providers seeking initial application and reappointment application for laser privileges will be processed by Provider Support Services.

Laser Safety Competency Assessment

Laser Safety Competency Assessment is required for the following: staff that assists laser procedures; and also for department designated Laser Safety Liaisons (LSL).

Incident/Accident Reporting

The MLSO 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 and impounded. The MLSO and Office of Risk Management shall be responsible for evaluating the accident and the safety of the laser device.

Information and Education links

VUMC LMS - login to LMS
https://learningexchange.vumc.org/#/dashboard

OSHA

Vanderbilt Environmental Health and Safety
http://www.safety.vanderbilt.edu/links/laser-safety.php

Perioperative Services:

Laser Related VUMC Policies

<table>
<thead>
<tr>
<th>Policy</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser Safety</td>
<td>CL SOP</td>
</tr>
<tr>
<td>Laser Maintenance</td>
<td>SA 70.10.02</td>
</tr>
</tbody>
</table>

References

2. AORN Guidelines for Perioperative Practice
**ENDOTRACHEAL TUBE INFORMATION**

### Laser-Shield II (Medtronic) – For CO2 (10,600 nm) and KTP (532 nm)

<table>
<thead>
<tr>
<th>Size (FR)</th>
<th>ID mm</th>
<th>OD mm</th>
<th>Reference No.</th>
<th>Item No. (VUMC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>5</td>
<td>8</td>
<td>7060200</td>
<td>4146</td>
</tr>
<tr>
<td>27</td>
<td>6</td>
<td>9</td>
<td>7060300</td>
<td>8093</td>
</tr>
<tr>
<td>31</td>
<td>7</td>
<td>10.5</td>
<td>7060400</td>
<td>8094</td>
</tr>
</tbody>
</table>

**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
- Do 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

<table>
<thead>
<tr>
<th>ID mm</th>
<th>OD mm</th>
<th>Balloon OD mm</th>
<th>Reference No.</th>
<th>Item No. (VUMC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>13.5 (nominal) – 13.7</td>
<td>27</td>
<td>102004</td>
<td>29323</td>
</tr>
</tbody>
</table>

**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

<table>
<thead>
<tr>
<th>Laser System</th>
<th>Power (W)</th>
<th>Laser Energy Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nd:YAG</td>
<td>100</td>
<td>5 sec</td>
</tr>
<tr>
<td>CO2, CW</td>
<td>40</td>
<td>120 sec</td>
</tr>
<tr>
<td>Ar</td>
<td>25</td>
<td>120</td>
</tr>
<tr>
<td>CO2, SP</td>
<td>15</td>
<td>120</td>
</tr>
<tr>
<td>Nd:YAG, 2f</td>
<td>5</td>
<td>120</td>
</tr>
</tbody>
</table>

### Laser Flex (Mallinckrodt) – Proven on CO2 and KTP

<table>
<thead>
<tr>
<th>Size (FR)</th>
<th>ID mm</th>
<th>OD mm</th>
<th>Reference No.</th>
<th>Item No. (VUMC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.5</td>
<td>7</td>
<td></td>
<td>86397</td>
<td>19656</td>
</tr>
</tbody>
</table>

**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.
LETTER OF SUPPORT

Date __________________

To the Laser Safety Program office:

This is to acknowledge that __________________________ (Dept/Pod/Clinic) is aware of the compliance requirements for laser safety, including the implementation of established institutional policies, and regulatory standards.

The department has designated ______________________ (staff name) as the laser safety liaison. The Laser Safety Liaison will be supported by the department/Pod/Clinic for its intended role in laser safety compliance.

Roles of Laser Safety Liaison:

1. Be knowledgeable of the education and training requirements for laser safety, the potential laser hazards and associated safety and quality requirements for all lasers used in the department.
2. Report known or suspected incidents/accidents to VEHS, Occupational, and Laser Safety Officer.
3. Ensure that lasers under their control are not operated or modified without approval from the MLSO, supervisor or Laser Safety Committee.
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 and provide laser operators with training in the administrative, safety and standard operating procedures.
7. Complete scheduled VUMC laser safety training programs.
8. Report known or suspected incident/accidents related to the use of laser to VEHS and Laser Safety Officer.

<table>
<thead>
<tr>
<th>Provider/Manager/Supervisor</th>
<th>Laser Safety Liaison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signature:</td>
<td>Signature:</td>
</tr>
<tr>
<td>Name:</td>
<td>Name:</td>
</tr>
<tr>
<td>Date:</td>
<td>Date:</td>
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<tr>
<td>Department:</td>
<td>Department:</td>
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<tr>
<td>Email:</td>
<td>Email:</td>
</tr>
<tr>
<td>Phone:</td>
<td>Phone:</td>
</tr>
</tbody>
</table>

For multiple areas utilizing laser systems, fill up another copy of letter of support for each designated laser safety liaisons.
# LASER SAFETY COMPLIANCE AUDIT TOOL

**Vanderbilt University Medical Center | Laser Safety Program**

<table>
<thead>
<tr>
<th>Department</th>
<th>Manager</th>
<th>Date</th>
<th>Compliance Score</th>
</tr>
</thead>
</table>

## Laser System Information

### A Administrative

<table>
<thead>
<tr>
<th>Administrative</th>
<th>Was Practice Performed?</th>
<th>Confirmation method</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Lasers are classified appropriately (class 3b, 4)</td>
<td>Yes (Met)</td>
<td>Observation</td>
<td></td>
</tr>
<tr>
<td>2. Manufacturer instructions for use available</td>
<td>No (Not Met)</td>
<td>Interview</td>
<td></td>
</tr>
<tr>
<td>3. Staff completed required laser safety training/competencies (e.g. staff and designated Laser Safety Liaison)</td>
<td>No (Not Met)</td>
<td>Both</td>
<td></td>
</tr>
<tr>
<td>4. Lasers are included in inventory and registered with the office of Laser Safety Program</td>
<td>No (Not Met)</td>
<td>Observation</td>
<td></td>
</tr>
<tr>
<td>5. Providers are credentialed for the appropriate laser wavelength</td>
<td>NA (Not Applicable)</td>
<td>Observation</td>
<td></td>
</tr>
<tr>
<td>6. Laser Procedures log completed appropriately (HIPPA policy observed)</td>
<td>No (Not Met)</td>
<td>Interview</td>
<td></td>
</tr>
<tr>
<td>7. Quarterly Laser safety audit and utilization report submitted to the office of LSPM</td>
<td>Yes (Met)</td>
<td>Observation</td>
<td></td>
</tr>
</tbody>
</table>

### B Engineering Control Measures

<table>
<thead>
<tr>
<th>Engineering Control Measures</th>
<th>Was Practice Performed?</th>
<th>Confirmation method</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Laser safety eye protection (goggles, eye shields) are appropriate for laser wavelength, routinely inspected and cleaned/disinfected.</td>
<td>Yes (Met)</td>
<td>Observation</td>
<td></td>
</tr>
<tr>
<td>2. Laser safety signs are appropriate for laser wavelength</td>
<td>Yes (Met)</td>
<td>Interview</td>
<td></td>
</tr>
<tr>
<td>3. Laser properly stored in a designated safe area</td>
<td>No (Not Met)</td>
<td>Interview</td>
<td></td>
</tr>
<tr>
<td>4. Laser keys are kept in an area ONLY accessible to authorized staff</td>
<td>Yes (Met)</td>
<td>Observation</td>
<td></td>
</tr>
<tr>
<td>5. Laser PM log current</td>
<td>Yes (Met)</td>
<td>Interview</td>
<td></td>
</tr>
</tbody>
</table>

| 6. Nominal Hazard Zone clearly defined (per VUMC laser safety policy)                    | Yes (Met)               | Observation          |          |
| 7. Laser hand pieces, delivery devices, adaptors, and lenses are appropriately cleaned, decontaminated, and/or sterilized between laser procedures per manufacturer recommendation (except for laser/fibers) | Yes (Met)               | Observation          |          |
| 8. Laser aperture is covered and protected from dust when not in use                      | Yes (Met)               | Interview            |          |
| 9. Appropriate smoke evacuation equipment and supplies are available (e.g. N-95 respirator, High-ffillation mask, filter change, equipment PM, tubing, wand, tip) | Yes (Met)               | Observation          |          |

### Recommendations/Comments

---
## Laser Safety Skills Competency Assessment Tool

### Skills Competency Criteria

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Self Assessment</th>
<th>Evaluation Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Have access and read institutional laser safety policies and laser specific manual/s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Completed required laser safety training with certificates/documentation on file (required annual training, vendor-sponsored, department-specific required in-service training)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Identifies specific laser system wavelength and required safety compliance (signs, eyewear, eye shield)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Performs pre-procedure safety checks (PM check, electrical safety, hazards check)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Identifies designated Nominal hazard Zone (NHZ) and implements safety compliance requirements: laser safety signs, eyewear, eye shield, window covers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Assembles/connects laser delivery systems (fibers, cables), and other laser safety accessory equipment (microscope, filters)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Operates laser control panel (power settings, pulse mode, time exposure, stand-by/ready, emergency shut off)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Tests laser beam for alignment or calibrates laser output</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Documents laser procedures and laser settings (dosimetry) in laser safety checklist/log or patient chart</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Creates, and stores laser system/accessories in secured area (Laser keys kept in secured)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Implements laser procedural fire safety precautions (O2 levels, laser ET tube, skin prep, dousing liquid, fire extinguisher)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Reports and communicates laser incident/accident appropriately</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Processes Loaner Laser Requests (required for designated laser safety liaison)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Submits Laser Safety report (utilization, audit) (required for manager or designated laser safety liaison)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Implements smoke management using appropriate smoke evacuator, high-filtration mask, N-95 (for transmissible diseases)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Reusable Laser hand pieces/accessories reproduced per institutional policy and/or manufacturer recommendations</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Assessee/Preceptor

```
I have successfully completed the required specific competencies as stated in the above criteria and understand that I am accountable for applying the above Skills Competency Criteria for Laser Safety.
```

**Print Name:**

**Sign:**

**Date:**

### Assessor/Proctor

```
Assessor/Proctor has successfully demonstrated the required specific competencies as stated in the above Skills Competency Criteria for Laser Safety.
```

**Print Name:**

**Sign:**

**Date:**