

A Primer for the Laser Safety Officer

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J Laser Dent 2011;19(1):168-171



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INTRODUCTION

This article is intended as an overview that describes the roles and responsibilities of a laser safety officer (LSO). The guidelines are presented in a 'checklist' style, rather than an essay for easier reading. It is hoped that these 'bullet points' will be helpful in highlighting important aspects of laser safety. The reader is encouraged to study the reference material listed at the end of the article.

The LSO's duties are based on documents from the American National Standards Institute (ANSI) headquartered in Washington, D.C., and the International Electrotechnical Commission (IEC) headquartered in Geneva, Switzerland. The Canadian Standards Association and the United Kingdom's Medicines and Healthcare products Regulatory Agency (MHRS) also publish standards, most of which are based on the ANSI documents. These institutions provide laser safety recommendations, but do not have any regulatory powers to make these guidelines inherent requirements.

However, in the United States, another agency, the Occupational Safety and Health Administration (OSHA) has a general authority to regulate workplace safety and relies on the recommendations described by industry consensus

State	Department	Regulation
Alaska	Environmental Conservation	Title 18, Article 7
Arizona	Radiation Regulatory Agency	Article 15 Title 12-1-1434 A, B
Arkansas	Division of Radiation Control & Emergency Management	Act 460
Florida	Department of Health & Rehabilitative Services	Non-Ionizing Chapter: 10D-89
Georgia	Department of Public Health	Chapter 290-5-27
Illinois	Department of Nuclear Safety	Chapter 111 ½
Massachusetts	Department of Public Health	105 CMR 21
Montana	Health and Environmental Services	92-003
New York	Department of Labor	Code Rule 50
Pennsylvania	Environmental Resources	Chapter 203, Title 25
Texas	Department of Health	Radiation Control Act, Parts 50, 60, 70
Washington	Labor & Safety	Chapter 296-62-WAC

Adapted from: United States Department of Labor, Occupational Safety & Health Administration, OSHA Technical Manual, Directive Number: TED 01-00-015, Effective Date: 1/20/1999, Table III:6-5. Summary of Current State Regulations. Available at: http://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_6.html, accessed February 27, 2011.

standards such as *ANSI Z136.1 Safe Use of Lasers* and *ANSI Z136.3 Safe Use of Lasers in Health Care Facilities*. OSHA citations are issued by invoking the general duty clause. Moreover, several states in the USA have additional specific regulations (and regulatory agencies) for the use of lasers, and are shown in Table 1.

THE LASER SAFETY OFFICER (LSO)

The Laser Safety Officer is an individual designated to be responsible for a laser or system of lasers and for the preparation and enforcement of a safety plan, including standard operating procedures for the safe operation of lasers. The LSO has the authority and respon-

sibility to monitor and enforce the control of laser hazards and to effect the knowledgeable evaluation and control of laser hazards.

All facilities where Class 4 lasers are in use are strongly recommended to have an LSO; however that person does not have to be a dentist, and is more often an auxiliary.

The duties of an LSO include:

- Writing and maintaining a laser safety manual
- Classifying lasers
- Evaluating hazards
- Defining control measures
- Ensuring that proper labels are posted and that personal protective equipment is worn
- Recording the specifications of the laser device(s) used, and recording maintenance
- Approving and supervising standard operating procedures
- Performing safety audits
- Ensuring that appropriate training and incident reporting take place.

The laser safety manual should contain adequate text to describe each point in the above list, as described below.

LASER CLASSIFICATION

- Class 1 laser: Incapable of producing damaging radiation levels and therefore poses no implicit risk.
- Class 2 laser: Emits accessible, visible radiation at levels at which damage from direct chronic or magnified exposure is possible. Dental uses include aiming beams, some photobiomodulation devices, and carious lesion detection instruments.
- Class 3 laser (subdivided into Class IIIA and Class IIIB): Can cause eye damage without protective eyewear, as well as slight skin damage. Dental uses include some photobiomodulation lasers and photodynamic anti-microbial chemotherapy devices.
- Class 4 laser: Causes damage to

the unprotected eye and skin with direct or diffuse (concentrated or reflected) exposures to the beam.

LASER HAZARDS

- Most of the emphasis of the regulations and policy is eye and skin damage.
- In engineering, medical, and research facilities that use lasers, there have been a few reports of eye damage; the only fatalities associated with the use of lasers were from electrocution. During periods of installation, maintenance, repair, calibration, and any other procedures which result in the accessibility to high-voltage components, the concern for electric shock is paramount.
- The Nominal Hazard Zone (NHZ) is that space where control measures are required, because laser radiation exceeds the maximum permissible exposure (MPE) which is the exposure value above which eye and skin damage would occur. In reality, one should consider the entire dental operatory as the NHZ.
- Nontarget hazards in the oral cavity should be recognized, such as tissue adjacent to the surgical site. The use of instruments with nonreflective surfaces should be considered.
- High temperatures from Class 4 lasers can cause fire hazards.

CONTROL MEASURES

- The laser's protective housing present and in good condition
- Nominal Hazard Zone (NHZ) determined (refer to the device owner's manual or contact the manufacturer); the appropriate hazard sign posted at the safe edge of that zone
- Surfaces that minimize specular reflections, including exposed watches and jewelry
- High-Volume Evacuator (HVE) present, and appropriate respiratory masks available
- Infection control standards

applied appropriately

- Area restricted to authorized personnel
- Emergency exit unobstructed; fire extinguishers or other safety equipment readily accessible
- Procedures provided for periodic maintenance and repair service on the equipment, including calibration checks

LABELING AND POSTING

- Certification label present
- Laser Class designation and appropriate warning label present
- Radiation output information on label
- Appropriate warning/danger sign at entrance to laser controlled area
- Warning posted for invisible radiation
- Warning labels present by aperture and interlocks

PERSONAL PROTECTIVE EQUIPMENT (PPE)

- Eye protection is appropriate for wavelength
- Eye protection has adequate Optical Density
- Warning/indicator lights can be seen through protective filters
- Eye protection glasses fit snugly, and have side shields
- Eye protection glasses have been inspected for scratches or other damage
- Adequate number of glasses for all present

LASER SPECIFICATIONS

- Laser Manufacturer: _____

- Manufacturer Contact Number: _____

- Model Number: _____

- Serial Number: _____

- Laser Location:

- Laser Type and Wavelength:

- Classification (3b or 4):

- Intended Application(s):

- Average Power (Watts):

- NHZ (Nominal Hazard Zone):

- Laser activation key storage location or password:

- Additional Comments:

Laser Safety Officer Training Record

Name: _____

Position: _____

List all laser or laser safety training course work you have completed. Note all the titles, dates completed, duration (hours of course) and locations. Include photocopies of certifications, if applicable. Suggested training shall also include the Manufacturer's Guide and Operating Manuals, Safety Guide Literature, Computer-Based Instruction, and Laser Safety Orientation.

Title of Training Program: _____

Date Completed: _____

Duration of Training: _____

Location of Training: _____

Instructor: _____

Signature: _____ Date: _____
(Laser User)

Signature: _____ Date: _____
(Laser Safety Officer)

Figure 1: Sample document to record LSO training

MAINTENANCE LOG

The record should accurately reflect:

- All maintenance procedures (calibration, replacement fibers, software upgrades, etc.)
- Service calls (reasons, what was done, date performed, and by whom)
- Any modification or change in supplies, disinfection, etc.

STANDARD OPERATING PROCEDURE (SOP)

The standard operating procedure for laser use should include a formal written description of the safety systems (including engineering controls) and administrative procedures to be followed during its operation. That list might include:

- Initial preparation of operatory environment for normal operation (controlled area designated, posting of signs, key/password access, air/water on, identification of personnel, preoperative inspection of laser, PPE, HVE present, other)
- Start-up procedures for the laser

(include inserting key, power on, test-fire, etc.)

- Proper operating parameters
- Shutdown procedures for this laser are as follows: (include device cleaning and infection control measures)
- Special procedures (emergency response, safety equipment, etc.)

A sample SOP could list the following points:

- Use the high-volume evacuation (HVE) in close proximity to the laser working area to remove laser-generated air contaminants in the plume.
- Changing laser tips or cleaving the fiber should be done only with the laser in standby mode or with the power off.
- Removing and reattaching the laser handpiece or fiber (usually for sterilization purposes, but also for replacement reasons) should be done only with the power off.
- Disinfection and sterilization protocols appropriate to surgical instruments will be followed.
- Always refer to the manufacturer's laser manual and operational guide for details.

TRAINING REQUIREMENTS

According to ANSI, the LSO and other employees routinely working with or around lasers are strongly recommended to participate in training that would consist of safety literature, audio and visual safety presentations, orientations, short-term formal courses, and review of applicable standards. The manufacturer's operating manual(s) that are included with each instrument should also be used as a resource.

A sample of an LSO's training record is shown in Figure 1.

LASER INCIDENT REPORT

In case of an adverse effect, an incident report must be completed and must include:

- Date of incident
- Time of incident
- Location of incident
- Identification of laser involved – wavelength(s) and power
- Description of laser incident and action taken
- Answers to questions such as:
 - Did this incident involve eye

exposure?

- Did this incident involve skin exposure?
- Was medical treatment sought?
- If so, how long after the incident?
- Signature of Laser User and Date
- Signature of LSO and Date

SUMMARY

The LSO is the person whose primary responsibility is to oversee the safe use of a laser instrument. The duties include identifying the safety mechanisms of the laser(s) used, identifying the hazards, ensuring that protective controls and supplies are used, ensuring infection control standards are followed, and ensuring proper training for the dental team members. Along with these responsibilities, the LSO must be familiar with various local and national regulations and diligently apply them. The fundamental principle of laser safety is that there is no compromise when it comes to protection of all those who are present when a laser is used.

AUTHOR BIOGRAPHY

Dr. Raminta Mastis graduated from the University of Illinois College of Dentistry in 1987. She is a Fellow of the Academy of Laser Dentistry and a Master of the Academy of Laser Dentistry. She has Standard Proficiency certifications in Er:YAG, diode, Er,Cr:YSGG, and CO₂ laser wavelengths, and has achieved Advanced Proficiency in the Er:YAG wavelength. She currently serves as the chair of ALD's Laser Safety Committee, serves on the Certification Committee, and is newly nominated to serve on the ALD Board. She maintains a private dental practice, Michigan Cosmetic and Laser Dentistry, in St. Clair Shores, Michigan. She has been using lasers since 2000, and now has 16 lasers of various wavelengths in her practice. Her practice is highlighted by implant surgery and restoration, laser dentistry, esthetic and cosmetic dentistry, and integration of advanced technologies

into practice. Dr. Mastis may be contacted by e-mail at MiLaserDentist@comcast.net.

Disclosure: Dr. Mastis has no commercial or financial interest relative to this article.

RESOURCES

1. International Electrotechnical Commission. www.iec.ch.*
2. American National Standards Institute. www.ansi.org.*
3. Laser Institute of America. www.laserinstitute.org.*
4. Laser Safety Committee, Academy of Laser Dentistry. Sweeney C, Coluzzi DJ, Parker P, Parker SPA, Sulewski JG, White JM. Laser safety in dentistry: A position paper. *J Laser Dent* 2009;17(1):39-49.
5. Sweeney C. Laser safety in dentistry. *Gen Dent* 2008;56(7):653-659; quiz 660-661, 767.

* Web sites were accessed February 27, 2011.) ■

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