ALD®
Academy of Laser Dentistry

DIY Guide

Do-It-Yourself Laser Safety Manual

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Laser Safety Manual

A Simple Guide to Establishing a Laser Safety Office Policy

Academy of Laser Dentistry
Laser Safety Manual

Laser Safety Manual
For Safe Use of Dental Lasers

This manual is authored by the Laser Safety Committee of the Academy of Laser Dentistry for our ALD members as a guide to preparing office policies and procedures on the safe use of lasers in dentistry. An appendix containing a glossary of terms, chart templates, and sample laser safety signs are included for reference. It is recommended to purchase the full text of the ANSI Z136.3-2011 *Safe Use of Lasers in Health Care* from the Laser Institute of America. **CLICK HERE for ALD and LIA Special Offer.**

Approved by the Academy's Board of Directors, November 2016

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The Academy of Laser Dentistry is a not-for-profit organization qualifying under Section 501(c)(3) of the Internal Revenue Code. The Academy of Laser Dentistry is an international professional membership association of dental practitioners and supporting organizations dedicated to improving the health and well-being of patients through the proper use of laser technology. The Academy is dedicated to the advancement of knowledge, research and education and to the exchange of information relative to the art and science of the use of lasers in dentistry. The Academy endorses the ***Curriculum Guidelines and Standards for Dental Laser Education.***

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INTRODUCTION

The Academy of Laser Dentistry (ALD) has established this Laser Safety Manual with customizable templates and general guidelines to aid members in developing a laser safety program in their facility in order to help ensure the safe use of lasers and laser systems in dental applications and in protecting the health and safety of patients, staff and the environment. The scope of this manual provides a general overview of laser safety control measures and is not intended to be comprehensive. Defining specific policies and procedures for each dental setting is the responsibility of the Laser Safety Officer. This document is written in accordance with current American National Standards Institute (ANSI) Z136.1–2014 (*Safe Use of Lasers*) and ANSI Z136.3 – 2011 (*Safe Use of Lasers in Health Care*), as well as US Department of Labor, Occupational Safety and Health Administration (OSHA) regulations.

As an adjunct manual to the ANSI Z136.3–2011 document, this manual provides the guidelines and customizable templates to assist the dental practitioner in the development and implementation of a laser safety program. This manual will be updated in accordance with new information as it becomes available. In concert with this manual, please refer to all applicable federal, state, country, or local regulations.

This manual is designed with the requirements of a non-institutional dental setting in mind. Larger organizations such as multi-department and/or multi-location dental group practices may need to consider a more complex administrative/organizational system possibly including roles separate from the Laser Safety Office (LSO), such as Deputy Laser Safety Officer(s) (DLSOs) and Laser Safety Site Contact(s) (LSSCs). ALD takes no responsibility for how the information in this manual is interpreted. ALD suggests contacting the Laser Institute of America (LIA) to purchase ANSI Z136.1 and ANSI Z136.3, as these texts reference the literature.

With the advancement of technology there are other treatment devices and equipment that utilize light emitting diodes (LEDs) and other light sources such as curing lights, oral scanners, and diagnostic tools, which pose optical hazards if not handled properly. All personnel should carefully read the manufacturer's instructions to ensure safe usage.

ADMINISTRATION

Laser Safety Officer

The Laser Safety Officer (LSO) is responsible for the laser safety program.

Requirements:

- Has training and experience to administer a laser safety program
- Is authorized by the healthcare facility administration (in a private dental office setting, this could be the dentist)
- May be a laser user, laser operator, or another trained person responsible for a laser safety program

Responsibilities:

- Confirms hazard classification of laser being used
- Assists with evaluation when a new laser is introduced
- Understands the operational characteristics of the laser(s) in the practice
- Knows the output limitations of the device
- Is familiar with the biological and other potential hazards of the laser
- Determines the controlled area and the potential hazard and non-hazard zones
- Ensures appropriate control measures are in effect, such as using correct warning signs posted at every entryway into the operatory in which the laser is being used, and that the laser signs are taken down after the procedure is completed, and not left up as "wallpaper"
- Ensures the laser is being operated by trained and authorized personnel only
- Approves and enforces policies and procedures for laser use, including procedural checklists
- Serves as the "keeper of the key" to secure the key or device password in a safe place when the laser is not in operation
- Oversees the appropriate laser protective eyewear availability, use and maintenance
- Ensures the appropriate protective equipment, such as high-volume evacuation, is in good working order and used appropriately
- Is authorized to shut down laser operation in cases of imminent danger from a laser hazard. This authority is to be recognized and respected in the dental office regardless of the dental employee position held by the LSO
- Ensures and maintains records of the laser safety education and training of the dental team
- Ensures laser maintenance, beam alignment, and calibration, and keeps a maintenance log
- Supervises medical surveillance and incident reporting
- Keeps current with safety standards, such as the American National Standards Institute (ANSI) Z136 series of laser safety standards, and the International Electrotechnical Commission (IEC) 60825 series, as well as Occupational Safety and Health Administration (OSHA) and state regulations (or those of the appropriate country) through educational meetings and literature review, and updates this information with the dental practice

Laser Users/Laser Operators

Requirements

- Laser safety training is required for all Class 3B and 4 laser users, operators, technical support staff, and allied health personnel

Responsibilities

- Keeps a log of recorded laser use and parameters employed
- Ensures proper test-firing of the laser prior to admission of the patient into the operatory

LASER CLASSIFICATIONS AND HAZARDS

In the United States, lasers and laser systems are divided into hazard classes based on the laser's potential to cause immediate injury to the eyes or skin upon direct exposure to the beam and/or secondary hazards related to the laser's composition. These hazard classes are often directly correlated with the power and wavelength of the emitted beam. The U.S. Federal Performance Standards for Light-emitting Products, 21 CFR 1040.10[1] requires all lasers, laser systems, and laser products and manufacturers to comply with specific laser regulations.

Class 1

Class 1 lasers generate a beam below the lowest maximum permissible exposure (MPE) levels when operated under normal, manufacturer-recommended conditions. These are typically any laser or laser system that cannot emit laser radiation at levels that are known to cause eye or skin injury during normal operation. Using Class 1 devices in a manner not in accordance with manufacturer instructions may be classified as a higher class laser and pose a hazard. Example: DVD player.[2]

Class 1M

Class 1M lasers produce a very low power beam that is safe for all normal use conditions except if viewed through optic devices. These are typically divergent beams or beams collimated to a wide diameter, where the power that can pass through the naked pupil is less than the accessible emission limit (AEL) for Class 1. Focusing the beam or collimating the divergent beam can create a hazardous beam. Class 1M lasers are considered incapable of producing hazardous exposure unless viewed with magnifying optics.

Class 2

Class 2 lasers emit a low power beam that falls within the visible light spectrum. While typically not acutely hazardous at a normal state, chronic exposure to Class 2 lasers can damage the eyes. In general, the physiologic gaze aversion response (0.25 second) is sufficient for protection from damage by Class 2 lasers. Class 2 lasers have a maximum visible beam output of 1 mW. Example: Some laser pointers.

Class 2M

Class 2M lasers emit a low power beam that falls within the visible light spectrum. Like Class 1M lasers, the power that can pass through the naked pupil is below the Class 2 AEL, but use with magnifying optics can create a hazardous beam.

Class 3R

Class 3R lasers have a maximum output of <5 mW. Unintentional exposure to the beam or viewing a diffuse reflection carries a low risk, but intentional exposure to a direct beam or specular reflection is potentially hazardous and should be avoided.

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[1] 21 CFR 1040.10 and 21 CFR 1040.11 were previously known, collectively, as the "Federal Laser Product Performance Standard" (FLPPS) and may be referred to as such by the Occupational Safety & Health Administration (OSHA), and in other documents, regarding laser hazards and safety measures.

[2] There is a laser classification 1C recognized in IEC 60825-1, generally designed for direct contact with skin. Because this class is not included in the ANSI classification system and lasers classified as 1C are not typically used in dentistry, it is omitted here.

Class 3B

Class 3B lasers emit a beam with a maximum power of <500 mW, and will cause eye injury if viewed directly or by specular reflection. Class 3B lasers typically do not pose a diffuse reflection or fire hazard for unintentional viewing, but do require specific safety control. Example: Low-Level Laser Therapy Devices.

Class 4

High-powered lasers (visible or invisible spectrum) present a potential acute hazard to the eye and skin for both direct exposure and for exposure to diffuse (scatter) reflections. Class 4 lasers also present a potential hazard for fire (ignition) and by-product emissions (laser plume). Example: Surgical lasers.

Table 1: Laser Classification, Power Output and Risk Analysis (adapted from Sweeney, 2012)

Laser Class	Maximum Output	Use in Dentistry	Possible Hazard	Safety Measures
Class 1 **Class 1M**	n/a n/a	Laser caries detection Scanner	No implicit risk Possible risk with magnified beam	Blink response Laser safety labels
Class 2 **Class 2M**	<1 mW <1 mW	Aiming beams Laser caries detection	Possible risk with direct viewing Significant risk with magnified beam	Sight aversion response Laser safety labels
Class 3R **Class 3B**	<5 mW <500mW	Aiming beams Low-level lasers Photodynamic anti-microbial chemotherapy devices Mucosal scanning chemofluoruescent devices	Eye damage Eye damage Maximum output may pose slight fire and skin risk	Safety eyewear Safety personnel Training for Class 3R and 3B lasers
Class 4	No upper limit	All surgical lasers	Eye and skin damage Nontarget tissue damage Fire hazard Plume hazard	Safety eyewear Safety personnel Training and local rules Possible registration to comply with natiional regulations

Table 2: Requirements by Laser Class
(ASC Z136, 2014)

Class	Control Measures	Training	LSO	Engineering Controls
1	Not Required	Not Required	Not Required	Not Required
1M	Required	Application Dependent[3]	Application Dependent[3]	Application Dependent[3]
2	Not Required[4]	Not Required[4]	Not Required	Not Required[4]
2M	Required	Application Dependent[3]	Application Dependent[3]	Application Dependent[3]
3R	Not Required[4]	Not Required[4]	Not Required[4]	Not Required[4]
3B	Required	Required	Required	Required
4	Required	Required	Required	Required

[3] Certain uses of Class 1M or Class 2M lasers or laser systems that exceed Class 1 or Class 2 because they do not satisfy certain measurement conditions may require hazard evaluation and/or manufacturer's information.
[4] Not required except for conditions of intentional intra-beam exposure applications.

LASER USE ENVIRONMENT

The Class 3B and Class 4 Health Care Laser System (HCLS) operating environment influences the choice of the most appropriate control measures.

Nominal Hazard Zone

The Nominal Hazard Zone (NHZ) describes the space within which the level of direct, reflected or scattered radiation, during normal operation, exceeds the applicable Maximum Permissible Exposure (MPE). (ASC Z136, 2011) The NHZ can vary from a few centimeters to many meters and is specific to the laser or laser system in use. The LSO determines the NHZ from information provided in the manufacturer's information for use or operator's manual. The LSO shall ensure that suitable safety practices and procedures are maintained within the NHZ. Under some conditions, the LSO may determine that control measures are required within the entire Laser Treatment Controlled Area (LTCA), such as situations that may arise involving movement of people in and out of the NHZ. In establishing the NHZ, the LSO shall ensure that consideration is given to direct, reflected and scattered radiation transmission through open doors or transparent windows, as well as the possibility of equipment malfunction (e.g., fiber breakage), or the intrusion of unauthorized unprotected people. No additional controls are required outside the NHZ. Anyone entering into the NHZ must have appropriate Personal Protection Equipment (PPE) including Laser Protective Eyewear (LPE). The NHZ must be clearly delineated with appropriate laser warning signs specific to the laser class and laser wavelength in use. The appropriate warning signs must hang at eye level outside each entry into the NHZ.

Laser Protective Barriers or Curtains

If a window or entryway into the dental operatory falls within the defined NHZ of a Class 3B or Class 4 laser system, a fire retardant filter or barrier is required at the entryway or on the windows to block or reduce any transmitted laser radiation to levels below the MPE.

HAZARD CONTROL MEASURES

General Considerations

Control measures are procedures or protocols by which hazards associated with the safe use of lasers are minimized. Control measures are divided into administrative, engineering, and procedural controls. Administrative controls are those control measures that form the infrastructure of the laser safety program and may include, but are not limited to, the performance and appointment criteria for the LSO, policies and other relevant documentation and audit, reporting and educational requirements. (ASC Z136, 2011)

Protective Equipment

Personal Protective Equipment (PPE) properly applied includes face masks, gloves, gowns, clothing and Laser Protective Eyewear (LPE). Proper LPE will have side shields, and are required to be labeled with the appropriate optical density (OD) rating for the specific wavelength and power of the laser with which it is being used. LPE is not designed for direct intrabeam viewing, which should be avoided.

Figure 1: Examples of Laser Protective Eyewear

Purpose

To prevent injuries to eyes and skin for personnel working with Class 3B and Class 4 lasers (Appendix E).

Policy

Within the NHZ, all personnel and patients should adhere to appropriate eye protection procedures during all laser applications. Under some conditions, the NHZ may include the entire operatory in which the laser procedure is performed. Under those conditions, the safety procedures listed below apply to the entire operatory. All personnel involved in the use or maintenance of laser systems should follow all safety procedures whenever a laser is in operation.

Procedure

1. LPE must be worn by all personnel and patients in the NHZ while the laser is in operation.
2. Prior to use, the operator and dental personnel should be responsible for selecting and examining laser protective eyewear for the appropriate OD and wavelength (as defined by the mandatory label on the eyewear), comfort and proper fit.
3. If the laser protective eyewear is damaged, it should not be worn and a report should be made to the Laser Safety Officer.
4. Contact lenses are not acceptable as protective eyewear. Prescription lens wearers should use appropriate laser eye protection.
5. All laser protective eyewear should have side shields to protect from peripheral injury and impact.
6. Any articulated arm of the laser system that is not shuttered should be capped when not connected to the handpiece or the operating microscope.
7. The laser system should be placed in standby mode when delivery optics are moved away from the target.

NON-BEAM HAZARDS

General

In addition to direct hazards to the eye, skin and other tissues caused by exposure to the laser beam, there are occupational and patient concerns associated with non-beam hazards created by a Health Care Laser System (HCLS). Due to the diversity of these potential hazards, the LSO shall enact necessary evaluations and control methods. Because of the diversity of these potential hazards, the LSO may employ safety and/or industrial hygiene personnel to conduct hazard evaluations. (ASC Z136, 2011)

Electrical Hazards

Lasers shall be installed and operated in conformity with the National Electrical Code (NFPA 70-2008), the Standard for Health Care Facilities (NFPA 99-2015), the Occupational Safety and Health Administration (OSHA), The Joint Commission [TJC, formerly known as The Joint Commission on Accreditation for Healthcare Organizations (JCAHO)], and related state and local laws and regulations (ASC Z136, 2011). Warning signs of electrical hazards include damaged electrical cords and cables, inadequately grounded HCLSs, use of conductive liquids, non-adherence to OSHA Lock-Out Standard, equipment not returned to its original operating condition following maintenance and/or service, workers contacting an energized conductor and completing circuit, and lack of demonstrated electrical safety training programs.

Fire and Combustion Hazards

Fire hazards associated with lasers take many forms. The most obvious is the use of flammable liquids including but not limited to isopropyl alcohol commonly used in the dental practice. Oxidizing gases such as nitrous oxide can be used with caution and with an appropriate scavenger system. Broken fibers, plastic parts, tubing and equipment can all potentially enhance the spread of fire. Failure of electrical equipment is always a hazard as a potential source of ignition. Care should be taken to ensure fire and combustion hazards are minimized or eliminated.

Laser Generated Airborne Contaminants (Laser Plume)

Laser Generated Airborne Contaminants (LGAC), also referred to as a laser plume or surgical smoke, are air contaminants generated when a laser beam is absorbed into target tissue. Analysis of the LGAC produced during laser procedures has shown the presence of gaseous toxic compounds, bio-aerosols, dead and living cellular material, and viruses. At certain concentrations some of the LGAC can cause ocular and upper respiratory tract irritation, have unpleasant odors, create visual problems for the operator and may have mutagenic and carcinogenic potential (ASC Z136, 2011). Appropriate protective measures include high-volume evacuation (HVE) at the surgical site to capture debris and prevent it from becoming airborne, PPE and LPE.

Infection Control and Sterilization

1) Centers for Disease Control and Prevention (CDC) guidelines for infection control in dentistry recommend the use of high-filtration surgical masks, central room suction units with in-line filters for minimal plumes, and dedicated smoke exhaust systems for substantial laser plumes. Laser safety eyewear appropriate for the wavelength in use should always be utilized to minimize infection risk.

2) All the components used (optic fibers, handpieces, and non-disposable tips) should be sterilized in separate sterilization pouches after each use, and according to the manufacturer's instructions. The fiber should never be sterilized together with a lubricated high-speed turbine. Adequate means to prevent the spread of infection shall be taken by utilizing Standard Precautions 29 CFR 1910.30.

Source: (ASC Z136, 2014)

LASER SAFETY TRAINING PROGRAMS

The LSO and other employees routinely working with or around lasers are strongly recommended to participate in training that may include safety literature, audio and visual presentations, orientations, short-term formal courses, and review of applicable standards. The manufacturer's operating manuals that are included with each laser should be used as a resource. See below for sample checklist of training subjects:

1. The Laser

a) Physics and biological effects
b) Dosimetry and beam parameters
c) Components of the laser system, delivery devices, and instrumentation
d) Overview of clinical applications

2. Administrative Controls

a) Laser committee
b) Role of the LSO
c) Development of policies and procedures
d) Documentation methods
e) Regulations, standards and recommended professional practices
f) Certification criteria and skills validation

3. Procedural Controls

a) Controlled access
b) Eye protection
c) Reflection hazards
d) Flammability hazards and draping
e) Electrical safety
f) Management of plume
g) Management of anesthesia in airway surgery
h) Equipment testing, aligning, and troubleshooting

APPENDIX A: POLICIES AND PROCEDURES

Policies and Procedures

Facilities using class 3B and class 4 lasers should have written Policy and Procedure Guidelines. These guidelines specify the safe use and operating procedures for the specific laser or laser system in use. The guidelines should be present at the operating console or control panel of the laser or easily available to any laser operator or assisting personnel. The guidelines should include at a minimum, operating instructions, PPE safety eyewear parameters and instructions for proper laser use. The guidelines should include clear warnings to avoid possible exposure to laser and collateral radiation in excess of the Maximum Permissible Exposure (MPE).

Policy and Procedures Guidelines (Mastis, 2011)[5]

The Policy and Procedure Guidelines should include, but are not limited to, the following:

a) Initial preparation of operatory environment for normal operation (controlled area designated, posting of signs, key/password access, air/water on, and identification of personnel, preoperative inspection of laser, PPE, HVE present, other)
b) Start-up procedures for the laser (include inserting key, password, power on, test-fire, etc.)
c) Proper operating procedures
d) Shutdown procedures for the laser in use (include device cleaning and infection control measures)
e) Special procedures (emergency response, safety equipment, etc.)

Sample Policy and Procedures (Mastis, 2011)[5]

a) Use the High-Volume Evacuation (HVE) in close proximity to the laser working area to remove laser-generated air contaminants in the plume
b) Changing laser tips or cleaving the fiber should be done only with the laser in standby mode or with the power off
c) 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
d) Non-disposable tips should be properly sterilized following usage according to manufacturer's guidelines
e) Soiled fiber tips should be disposed of in a sharps biohazard waste container
f) Disinfection and sterilization protocols appropriate to surgical instruments should be followed
g) Always refer to the manufacturer's laser manual and operational guide for details

[5] Reproduced with minor changes with permission from R. Mastis and the Academy of Laser Dentistry

APPENDIX B: EYE AND SKIN LASER HAZARDS

Table 3: Eye and Skin Laser Hazards [Adapted from: (Dorros, 1991)]

Laser	Eye Structure	Eye Damage	Skin
Diode 445-450 nm	Retina	Retinal Lesion	Skin Burn and Photosensitive Reactions
Diode 808 – 1064 nm	Retina Lens (above 700 nm)	Retinal Lesion Retinal Burn and Cataract (above 700 nm)	Skin Burn
Nd:YAG 1064 nm	Retina Lens	Retinal Burn Cataract	Skin Burn
Er,Cr:YSGG 2,780 nm and Er:YAG 2,940 nm	Lens Aqueous Humor Cornea	Cataract Aqueous Flare Corneal Burn	Skin Burn
CO_2 9,300 nm and 10,600 nm	Cornea	Corneal Burn	Skin Burn

APPENDIX C: AREA WARNING SIGNS

Figure 2: Class 4 Warning Sign

WARNING

Class 4 Laser Controlled Area

Avoid eye or skin exposure to direct or scattered radiation.

Laser protective eyewear required:

OD_____@_____nm

Laser type:_____

Peak power/maximum average power:
_____W/_____W

Laser Safety Officer:_____ **Phone:_____**

Fully editable: Add optional precautionary instructions in top right field under "Class 4 Laser Controlled Area"

Source: Laser Safety Committee, Academy of Laser Dentistry, based on ANSI Z136.1-2014 (ASC Z136, 2014)

Figure 3: Class 3B Warning Sign

⚠ WARNING

Class 3B Laser Controlled Area

Avoid eye exposure to direct beam.

Laser protective eyewear required:
OD_____@_____nm

Laser type:_____

Laser power:_____

Laser Safety Officer:_____ **Phone:**_____

Fully editable: Add optional precautionary instructions in top right field under "Class 3B Laser Controlled Area"

Source: Laser Safety Committee, Academy of Laser Dentistry, based on ANSI Z136.1-2014 (ASC Z136, 2014)

Figure 4: Class 3R Caution Sign

⚠ CAUTION

Class 3R Laser In Use

Avoid direct exposure to eyes.

Laser protective eyewear required:

OD_____@_____nm

Laser type:

Maximum power:

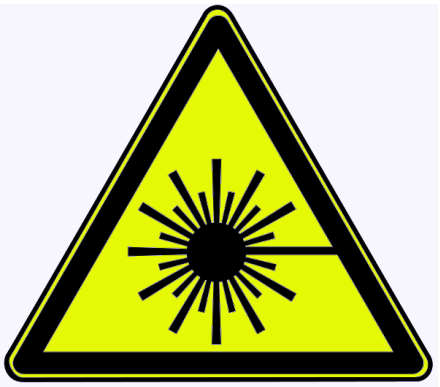
Laser Safety Officer:_____ **Phone:_____**

Fully editable: Add optional precautionary instructions in top right field under "Class 3R Laser In Use"

Source: Laser Safety Committee, Academy of Laser Dentistry, based on ANSI Z136.1-2014 (ASC Z136, 2014)

Figure 5: Class 2M Caution Sign

⚠ CAUTION



Class 2M Laser In Use

Do not stare into beam or view directly with optical instruments.

Laser protective eyewear required:

OD_____@_____nm

Laser type:

Maximum power:

Laser Safety Officer:_____ **Phone:_____**

Fully editable: Add optional precautionary instructions in top right field under "Class 2M Laser In Use"

Source: Laser Safety Committee, Academy of Laser Dentistry, based on ANSI Z136.1-2014 (ASC Z136, 2014)

APPENDIX D: SAFETY PROCEDURES FOR NON-BEAM HAZARDS[6]

Fire

1) Never use alcohol near a laser in use. Fibers may be rinsed or wiped in saline saturated gauze.
2) Never place a hot fiber directly on paper flammable drapes.
3) Use fire-retardant drapes, damp packs or pads.
4) Put laser system in standby mode when procedure is interrupted or paused.
5) Appropriately manage the use of oxygen in the area of laser treatment. Nitrous oxide can be used with a laser if an appropriate scavenger system exists.
6) Avoid laser beam exposure of the sheaths of flexible fiber endoscopes, since many of the sheaths are flammable.
7) Fire extinguishers must be easily accessible and all personnel must be competent in their proper use.

Laser Generated Airborne Contaminants (LGAC) or Laser Plume Management

1) Remove laser-generated airborne contaminants from the energy impact site to reduce the transmission of potentially hazardous particulates.
2) Use high-volume evacuation to manage the laser plume.
3) Check operation of the high-volume evacuation prior to the beginning of the procedure.
4) If employing the use of a separate plume evacuator, check the plume filter monitor, and if needed, install a clean filter. Dispose of used filter according to biohazard procedures.
5) In-line filters, such as high-volume evacuation will be placed between wall suction and the fluid canister and will be changed as directed by the manufacturer and used filter disposed of according to biohazard procedures.
6) Use appropriate plume evacuation even in cases producing minimal plume.
7) Stop procedure if failure of evacuator occurs before or during operation.
8) All tubing, connectors, adaptors, and wands will be changed per case, and disposed of according to biohazard procedures.

Electrical Shock

NOTE: During service or maintenance, precautions must be taken against electrical shock, which can cause bodily injury and, in some cases, be fatal.

1) Install HCLS lasers to National Electrical Codes.
2) Keep log of all maintenance and service records.

[6] (ASC Z136, 2011)

APPENDIX E: LASER INCIDENT REPORTING[7]

In case of a laser-related injury or damage incident, the LSO completes an incident report and submits the report to the laser manufacturer. The incident report 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

Table 4: Laser Incident Reporting Sample Template

Date and Time	Operator and Witness	Location	Laser(s) Involved and Parameters	Description of Incident	Specifics	Corrective Action Taken	Signature of LSO

Source: Laser Safety Committee, Academy of Laser Dentistry (2017)

[7] (ASC Z136, 2011)

APPENDIX F: LASER REGISTRATION FORM

GENERAL INFORMATION – Please print legibly

Laser Safety Officer_____

Department_____

Address_____ Phone #_____

Email_____ Zip Code_____

Location of laser (room & building) _____

Manufacturer_____ Model_____

Laser Serial number_____ Class_____

Manufacturing Date _____

Status of unit: ___Operable ___Inoperable ___Stored

Date placed in service: _____

Laser type (CW, pulsed): _____

Wavelength(s) (Diode, Nd:YAG, Er,Cr:YSGG, Er:YAG, CO_2, etc.)_____nm

Maximum power (Watts) or energy (Joules)_____

Pulse duration (if applicable)_____, Frequency_____

Emerging beam divergence_____

Beam diameter_____

Has laser been modified from the original? ___Yes ___No

Description of changes made_____

APPENDIX G: LASER CALIBRATION & MAINTENANCE LOG

Table 5: Laser Calibration and Maintenance Log

Date	Laser Type	Procedure (calibration, replacement fibers, etc.)	Service Calls	Who Performed?	Any change in supplies, disinfection, etc.

Source: Laser Safety Committee, Academy of Laser Dentistry (2017)

APPENDIX H: LASER PROTECTIVE EYEWEAR MAINTENANCE LOG

Table 6: Laser Protective Eyewear Maintenance Log

Date	Glasses #	Integrity (New, Good, Bad)	If not compliant, reason being disposed of	Date Ordered New

Source: Laser Safety Committee, Academy of Laser Dentistry (2017)

APPENDIX I: 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 should also include the Manufacturer's Guide and Operations Manuals, Safety Guide Literature, Computer-Based Instruction, and Laser Safety Orientation programs.

Title of Training Program: _____

Date Completed: _____

Duration (Hours) of Training: _____

Location of Training: _____

Instructor or Institute: _____

Additional Training Courses:

_____

_____

GLOSSARY

AEL: The ANSI Z136.1 2014 defines Accessible Emission Limit or AEL as the maximum accessible emission level permitted within a particular laser hazard class.

ANSI: American National Standards Institute is a not-for-profit organization, founded in 1918, that oversees the administration and coordination of the United States private sector voluntary standardization system.

ASC Z136: Accredited by the American National Standards Institute, ASC Z136 is the volunteer committee responsible for the development of the ANSI Z136 series of laser safety standards. The Laser Institute of America (LIA) serves as the administrative sponsor and secretariat to ASC Z136.

FDA: The U.S. Food and Drug Administration is a division of the U.S. Department of Health and Human Services, founded through consolidation in 1930. The FDA enacts the provisions of the Federal Food, Drug and Cosmetic Act (rev. 2004). The FDA Center for Devices and Radiological Health (CDRH) is responsible for the premarket approval of all medical devices, as well as overseeing the manufacturing, performance and safety of these devices.

Federal Performance Standards for Light-emitting Products: Previously known as the U.S. Federal Laser Product Performance Standard (FLPPS), requires all lasers, laser systems, and laser products and manufacturers to comply with specific laser regulations. These can be found in the U.S. Code of Federal Regulations (CFR 21 subchapter J, Part I sections 1002 – 1040.11).

HCLS: Health Care Laser System. Class 3B, Class 4 HCLSs operation requires a guarded switch.

HCP: Health Care Personnel

HVE: High-volume evacuation. HVE is a vacuum system designed for removal and disposal of substances from the patient's mouth.

IEC: International Electrotechnical Commission. Founded in 1906, the IEC is a not-for-profit, nongovernmental international organization that prepares and publishes consensus-based international standards for all electrical, electronic, and related technologies. The headquarters are in Geneva, Switzerland.

L6A: Defines the suitability for the eyewear within clinical, industrial, or research conditions.

LASER: An acronym for "light amplification by stimulated emission of radiation." A laser is a coherent, and often highly collimated light source which may carry a significant amount of energy in a beam with a small cross-section.

LGAC: Laser Generated Airborne Contaminants (LGAC), also referred to as laser plume or surgical smoke, can contain blood, blood by-products, and pathogens. Users should use control measures such as standard precautions, that are covered by the blood-borne pathogen standard.

LPE: Laser Protective Eyewear

LSO: Laser Safety Officer, an individual designated to be responsible for a laser or system of lasers. The LSO is responsible for the preparation and enforcement of a safety plan, including the standard operating procedures for the safe operations of lasers. The LSO has the authority and responsibliity to monitor and enforce the control of laser hazards and to effect the knowledgeable evaluation and control of laser hazards.

MPE: Maximum Permissible Exposure. This represents a value of exposure to laser energy above which a risk of target damage may occur. MPE values are applied to the unprotected eye and skin.

NHZ: Nominal Hazard Zone. This is the area around a laser in which the Maximum Permissible Exposure (MPE) is being exceeded.

NOHD: Nominal Ocular Hazard Distance. The NOHD is that distance from the emission port of the laser beyond which any exposure is within MPE values.

OD: Optical Density. The OD is the ability of the glass or polycarbonate shield to attenuate the laser beam. It refers to the opacity of the protective filter.

OSHA: Occupational Safety and Health Administration. OSHA, created in 1971, is a division of the U.S. Department of Labor. OSHA serves to ensure safety and health in the workplace.

PPE: Personal Protective Equipment used to reduce exposure associated with laser and biologic (infection) hazards. PPE includes laser protective eyewear, protective gowns, masks, and gloves.

P/Ps: Written Policies and Procedures that list administrative safety control measures and procedural safety protocols.

WORKS CITED

ASC Z136. (2011). *ANSI Z136.3-2011 American National Standard for Safe Use of Lasers in Health Care.* Orlando, FL: Laser Institute of America.

ASC Z136. (2014). *ANSI Z136.1-2014 American National Standard for Safe Use of Lasers.* Orlando, FL: Laser Institute of America.

Dorros, G. S. (1991). *Understanding Lasers: A Basic Manual for Medical Practitioners.* Mt. Kisco, NY: Futura Publishing Co.

Mastis, R. (2011). A Primer for the Laser Safety Officer. *Journal of Laser Dentistry*, 168-171.

Sweeney, C. C. (2012). Laser Safety in Dentistry: A Position Paper. *Journal of Laser Dentistry, 20*(2), 54-64.