

**THE UNIVERSITY OF OKLAHOMA
LASER SAFETY PROGRAM**

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THE UNIVERSITY OF OKLAHOMA LASER SAFETY PROGRAM

I. INTRODUCTION

The use of lasers is more common in today's work and research environment. Lasers may present a variety of potentially serious hazards. Laser radiation may cause injury to the eyes and the skin. Electrical and fire hazards can also be present with high-powered lasers. Hazardous chemicals may also be used in conjunction with lasers.

All protocol established under this program are based primarily on the United States Department of Labor, Occupational Safety and Health Administration (OSHA) directives for the *Guidelines for Laser Safety and Hazard Assessment*, the American National Standards Institute (ANSI), *Guide for the Safe Use of Lasers*, ANSI Z136.1–2000, *ANSI Guide for the Safe Use of Lasers in Health Care Facilities*, ANSI Z136.3–1996, and *ANSI Guide for the Safe Use of Lasers Outdoors*, ANSI Z136.6–2000.

Definitions of terms used in this program may be found in Appendix A.

II. SCOPE

This program applies to the University of Oklahoma, all its campus locations and ancillary operations. The program describes policies for the safe use of lasers used under the direction of any employee, facility member, resident or student.

III. RESPONSIBILITIES

- A. The Director of Compliance for the University of Oklahoma is responsible for:
 - 1. Approving the appointment of an Institutional Laser Safety Officer (LSO) for the University of Oklahoma, and
 - 2. providing continuing support for institutional health and safety by enforcing this Laser Safety Program.

- B. The Environmental Health and Safety Office (EHSO) will:
 - 1. appoint an LSO for the University of Oklahoma,
 - 2. approve the appointment of Assistant Laser Safety Officer(s) where necessary or feasible,
 - 3. maintain training records required by this program,
 - 4. conduct audits of University-related laser operations, and

5. review this written program at least annually or as needed.
- C. The Laser Safety Officer (LSO) is responsible for:
1. maintenance of the *OU Laser Safety Program*,
 2. reviewing laser safety procedures,
 3. evaluation of the hazards and controls associated with lasers used at OU,
 4. establishing the boundaries of each Nominal Hazard Zone (NHZ) for each laser which requires a hazard zone assessment,
 5. providing training as required by this program,
 6. appointment of Assistant Laser Safety Officers as needed, and
 7. maintaining an accurate accounting of Class 3 and Class 4 laser locations within the University of Oklahoma. See Appendix D for laser inventory form.
- D. Assistant Laser Safety Officer(s) (ALSO) are responsible for:
1. performing the functions of the LSO for the area of his/her responsibility, as assigned by the LSO; and
 2. reporting to the LSO in all matters related to this program.
- E. Department Chairs of departments in which lasers are used are responsible for:
1. complying with and enforcing the *Laser Safety Program* within their respective department, and
 2. appointing a designated Laser Safety Coordinator (LSC) for that department. Personnel appointed as an LSC should:
 - a. have a good working knowledge of the lasers in the department,
 - b. be able to fulfill the duties outlined in this document, and
 - c. have the authority to stop unsafe practices or procedures without adverse repercussions. Examples of personnel qualified to be appointed as an LSC include principle investigators, laboratory managers, faculty, clinic managers, lead nurses, etc.
- F. Laser Safety Coordinators (LSC) are responsible for:
1. determining the proper classification of the lasers used within the department, writing

- and updating appropriate departmental laser safety procedures and standard operating procedures as required by this program, and ensuring that they are followed;
 2. ensuring that employees are provided with and properly don appropriate protective equipment;
 3. ensuring all warning labels are properly posted for the laser under their area of responsibility;
 4. notifying the LSO when lasers are acquired or retired by the department; and
 5. maintaining all documentation appropriate to verify compliance with this program.
- G. Each employee who has the potential to be affected by this program is responsible for:
1. complying with the provisions of this *Laser Safety Program*,
 2. attending training sessions as may be required,
 3. performing his/her job in accordance with safety precautions communicated to him/her during training sessions and other educational programs,
 4. operating all equipment in accordance with laser safety procedures and standard operating procedures as required by this procedure, and
 5. notifying his/her supervisor immediately in the event of any incident or exposure related to laser use.

IV. LASER CLASSIFICATION GUIDELINES

- A. Laser classification is based on the maximum output available for the intended use as follows.

Class 1: A laser which cannot emit laser radiation at known hazard levels (typically 0.4 micro watts (μW) as visible wavelengths.) Users of Class 1 laser products are exempt from radiation hazard controls during operation and maintenance.

Class 2: Low power visible laser, which emit above a Class 1 levels but emitting a radiant power not above 1 milliwatt (mW). Class 2 applies only to visible laser emissions which may be viewed only for time periods less than or equal to 0.25 seconds.

Class 3a: Intermediate power laser (cw: 1-5 mW). Only hazardous for intra-beam viewing.

Class 3b: Moderate power lasers (cw: 5-500 mW, pulsed: 10 J/cm² - or the diffuse reflection limit, whichever is lower) Class 3b lasers will not be a fire hazard and are not generally

capable of producing a hazardous diffuse reflection except when intentional staring is done at distances close to the diffuser. Lower-power Class 3b lasers are those that do not exceed the Class 3a AEL by more than 5 times.

Class 4: High power lasers (cw: 500 mW) are hazardous to view under any condition (directly or diffusely scattered) and are a potential fire hazard and skin hazard.

- B. The departmental LSC is responsible for determining the proper classification of all laser(s) systems in use under his/her area of responsibility. Factors which the LSC must consider when determining the laser system hazard classification are:
1. the laser's maximum output available for the intended use;
 2. the laser system's capability of injuring personnel, including whether shielding is present; and
 3. the environment in which the laser is to be used, such as whether hazardous gases are also present.

V. GENERAL INFORMATION APPLICABLE TO ALL LASERS

A. GENERAL CONSIDERATIONS

For all users of lasers and lasers systems, it is recommended that the minimum laser radiation required for the application be used and that the beam height be maintained at a level other than the normal eye position of a person in the standing or seated position.

Engineering controls (items incorporated into the laser or laser system or designed into the installation by the user) should be given primary consideration in instituting a control measure for limiting access to laser radiation.

Enclosure of the laser equipment or beam path is the preferred method of control, since the enclosure will isolate or minimize the hazard.

B. LOCATION OF CONTROLS

Each laser should have the controls placed so that adjustment of those controls does not expose the operator to a specular or direct laser beam above the applicable Maximum Permissible Exposure (MPE). See Appendix B for Laser Exposure Tables.

C. PROTECTIVE HOUSINGS

A protective housing should be provided for all classes of laser or laser systems (except as noted by section V. D.). Since service personnel may remove protective housings, e.g., for alignment, special

safety procedures may be required, and the use of appropriate eyewear and signage is recommended.

D. OPERATING A LASER WITHOUT PROTECTIVE HOUSING

In some circumstances, such as research and development and servicing of lasers, operation of lasers or laser systems without a protective housing may become necessary. In such cases, the LSO should perform a hazard analysis, develop written control measures appropriate to the class of maximum accessible emission level, and ensure that control measures are instituted to ensure safe operation. These controls may include, but are not limited to:

1. establishment of a laser controlled area,
2. eye protection,
3. barriers, shrouds, beam stops. etc.,
4. administrative and procedural controls, and
5. education and training.

VI. SPECIFIC LASER REQUIREMENTS FOR EACH CLASS OF LASER

A. CLASS 1

1. Standard Operating Procedures (SOP) – specific SOPs are not required.
2. Education and Training – Any operator of a Class 1 laser should be familiar with the manufacturer's guide and operating instructions for basic laser safety information. Documented training is not required.
3. Alignment Procedures – Class 1 lasers are exempt from having formal alignment procedures. NOTE: Class 3 or Class 4 lasers embedded in Class 1 housings (considered Class 1 lasers during operation) require formal alignment procedures during maintenance and alignment. These lasers systems should refer to section *V.D. OPERATING A LASER WITHOUT PROTECTIVE HOUSING*.
4. Eye Protection – special eye protection is not required.
5. Skin Protection – not required.
6. Area Signage – no special signage is required beyond the requirements established by the manufacturer.
7. Medical Examinations - not required.

8. Service Access Panels – not required.
9. Key Control – not required.
10. Activation Warning System – not required.
11. Indoor Laser Controlled Area – not required.
12. Outdoor Hazard Evaluation – not required.
13. Interlocks on Protective Housing – not required
14. Unattended Laser Operation – Class 1 lasers may be used for unattended operation in unsupervised areas without additional control measures.

B. CLASS 2

1. Standard Operating Procedures – specific SOPs are not required.
2. Education and Training – Any operator of a Class 2 laser should be familiar with the manufacturer’s guide and operating instructions for basic laser safety information. Documented training is not required, however the LSC should inform operators of a Class 2 laser that intentionally pointing a Class 2 laser at any person’s eyes is forbidden.
3. Alignment Procedures – Class 2 lasers should be aligned by service personnel or other individuals with the knowledge and training to ensure no persons are exposed to the primary beam or any specular or diffuse radiation above the MPE for the equipment being aligned.
4. Eye Protection – no special eye protection is required unless in the opinion of the LSO or ALSO, the laser procedure may expose an individual’s eyes to a Class 2 laser for a duration in excess of 0.25 seconds. In that case, eye protection appropriate for the wavelength of the laser is required.
5. Skin Protection – not required.
6. Area Signage – areas in which lasers which exceed the MPE for irradiance are used require “Caution” signage at the entrance to the area where the laser system is located. See Appendix C for label example of signage. Signs should be located at the entrance of the area.
7. Medical Examinations – not required.
8. Service Access Panels – not required.

9. Key Control – not required.
10. Activation Warning System – not required.
11. Indoor Laser Controlled Area – not required.
12. Outdoor Hazard Evaluation – if the LSO or ALSO maintains an opinion that a Class 2 laser will be used at night in ways which could interfere with persons operating vehicles, an outdoor hazard evaluation must be performed by the LSO/ALSO.
13. Interlocks on Protective Housing – not required.
14. Unattended Laser Operation – Class 2 lasers may be used for unattended operation in unsupervised areas without additional control measures, **if** in the opinion of the LSC contact to the direct or reflected beams by unprotected spectators does not exceed the applicable MPE.

C. CLASS 3a

1. Standard Operating Procedures – specific SOPs are not required; manufacturer’s SOPs should be used.
2. Education and Training – Any operator of a Class 3b laser should be familiar with the manufacturer’s guide and operating instructions for basic laser safety information. Documented training is not required.
3. Alignment Procedures – Class 3a lasers should be aligned by a technician or other individual with the knowledge and training to ensure no persons are exposed to the primary beam or any specular or diffuse radiation above the MPE for the equipment being aligned.
4. Eye Protection – no special eye protection is required unless in the opinion of the LSO or ALSO the laser procedure may expose an individual’s eyes in excess of the MPE for that laser. In that case, eye protection appropriate for the wavelength of the laser is required.
5. Skin Protection – not required.
6. Area Signage – areas in which Class 3a lasers which **do not** exceed the MPE for irradiance are used require “Caution” signage at the entrance to the area where the laser system is located. Class 3a laser systems which exceed the MPE for irradiance require a “Danger” area warning sign. See Appendix C for label example of signage.
7. Medical Examinations – not required.

8. Service Access Panels – not required.
9. Key Control – not required.
10. Activation Warning System – not required.
11. Indoor Laser Controlled Area – not required.
12. Outdoor Hazard Evaluation – if the LSO or ALSO maintains an opinion that a Class 3a laser will be used at night in ways which could interfere with persons operating vehicles, an outdoor hazard evaluation must be performed by the LSO/ALSO.
13. Interlocks on Protective Housing – not required.
14. Unattended Laser Operation – Class 3a lasers may be used for unattended operation in unsupervised areas without additional control measures, **if** in the opinion of the LSO/ALSO contact to the direct or reflected beams by unprotected spectators does not exceed the applicable MPE.

D. CLASS 3b

1. Standard Operating Procedures – SOPs including alignment should be written by the LSC from the manufacturer’s recommendations and taking into account their knowledge of the laser system application and any other ancillary hazards associated with the Class 3b laser(s) under his/her area of responsibility. These SOPs should be approved by the LSO prior to commencement of laser operations.
2. Education and Training – Any operator, maintenance, or service personnel of a Class 3b laser must be trained on the manufacturer’s guide and operating instructions for basic laser safety information prior to operation of the laser(s) and whenever any change to procedures or equipment occurs. Training should be documented and should include, but not be limited to:
 - a. departmental and/or alignment SOPs as applicable including emergency shutdown procedures;
 - b. campus emergency response procedures; and
 - c. emergency contact information.
3. Alignment Procedures – Class 3b lasers should be aligned by a technician or other individual with the knowledge and training to ensure no persons are exposed to the primary beam or any specular or diffuse radiation above the MPE for the equipment being aligned, and should be done in accordance with the alignment SOPs developed for that laser.
4. Eye Protection – Enclosure of the laser beam path is the preferred method of hazard

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- control. However, if this is impractical, eye protection appropriate for the wavelength of the laser for all operator(s), maintenance workers, spectators and service personnel is required when the laser system is engaged.
5. Skin Protection – The requirements for skin protection should be as indicated by the laser manufacturer, as specified in their safety information. A standard surgical glove will usually provide adequate protection in the far UV. Tightly woven fabrics and other materials may be necessary in the UV-A. A surgical gown can provide protection for the arms. Consideration should be given to fire retardant material when a fire hazard exists
 6. Area Signage – areas in which Class 3b lasers are used require a “Danger” area warning sign located at the entrance to the area where each laser system is located. See Appendix C for label example of signage.
 7. Medical Examinations - University employees who are operators, maintenance, or service personnel for Class 3b lasers should receive a medical examination prior to participation in laser work or following any suspected laser injury consisting of ocular history and visual acuity. See section IX. D *Medical Facility Arrangements* for the recommended facility for each campus.
 - a. If the ocular history shows no problems and visual acuity is found to be 20/20 (6/6/ in each eye for far, and Jaeger 1+ for near) with corrections (whether worn or not) and Amsler Grid Test and Color Vision responses are normal, no further examination is required.
 - b. Any deviations from acceptable performance will require an identification of the underlying pathology either by fundoscopic examination, or other tests as determined appropriate by the responsible medical or optometric examiner.
 8. Service Access Panels – Class 3b laser service access panels when utilized must:
 - a. have a warning label attached to the panel, and
 - b. be interlocked or require a tool for removal.
 9. Key Control – not required.
 10. Activation Warning System – not required.
 11. Indoor Laser Controlled Area – The LSO or ALSO must perform a hazard analysis of each Class 3b laser system. If the hazard analysis determines that there is accessible radiation, a laser controlled area should be established which:
 - a. is located so that access to the area by spectators is limited and entry approval is required from the LSC,
-

- b. has any potentially hazardous beam terminated with a beam stop,
- c. has only diffusely reflecting material in or near the beam path,
- d. requires personnel within the laser controlled area wear the appropriate eye protection,
- e. ensures that the laser is secured such that the beam path is above or below eye level of a person in the standing or seated position, and
- f. has all windows and doorways from an indoor facility either covered or restricted in such a manner as to reduce the transmitted laser light to below the MPE.

12. Outdoor Hazard Evaluation – Class 3b lasers require that an outdoor hazard evaluation be performed by the LSO/ALSO to include but not limited to:

- a. an evaluation of the engineering controls,
- b. establishing the NHZ,
- c. identifying personal protective equipment to be used within the NHZ, and
- d. incorporating these requirements into the SOPs.

In addition, the SOPs should reflect that the NHZ is to be clearly posted with laser warning signs and that all personnel authorized to enter the NHZ are appropriately trained in the requirements of Class 3b lasers. See Section VII. B for additional requirements for outdoor use.

13. Interlocks on Protective Housing – Class 3b lasers require a protective housing interlock which should not be defeated or overridden during operation unless recommended control measures are adhered to. Adjustments or procedures during service on lasers or laser systems containing interlocks should not cause the interlocks to be inoperative when the equipment is restored.

14. Unattended Laser Operation – Class 3b lasers should be used for unattended operation in unsupervised areas only when:

- a. the LSC/LSO has implemented control measures that provide adequate protection and laser safety training for those who may enter the laser controlled area during times of unattended use, and
- b. all areas where unattended Class 3b lasers operate have “Danger” laser safety warning signs (see Appendix B) posted along with instructions on the hazards of entry into the space when no operator is present.

E. CLASS 4

1. Standard Operating Procedures – SOPs should be written by the LSC from the manufacturer’s recommendations by taking into account their knowledge of the laser system application and any other ancillary hazards associated with the Class 4 laser(s) under his/her area of responsibility. These SOPs should be approved by the

LSO prior to commencement of laser operations. In addition, alignment SOPs should be written by the LSC by taking into account the manufacturer's recommendations and their knowledge of the laser system application for the Class 4 laser system under his/her area of responsibility. These SOPs should be approved by the LSO prior to commencement of laser operations.

2. Education and Training – Any operator, maintenance, or service personnel of a Class 4 laser must be trained on the manufacturer's guide and operating instructions for basic laser safety information prior to operation of the laser(s) and whenever any change to procedures or equipment occurs. Training should also include, but not be limited to:
 - a. departmental and/or alignment SOPs as applicable including emergency shutdown procedures,
 - b. campus emergency response procedures, and
 - c. emergency contact information.
3. Alignment Procedures – Class 4 lasers should be aligned by a technician or other individual with the knowledge and training to ensure no persons are exposed to the primary beam or any specular or diffuse radiation above the MPE for the equipment being aligned. Furthermore this should be done in accordance with the Alignment SOPs developed for that laser.
4. Eye Protection – Enclosure of the laser beam path is the preferred method of hazard control. However, if this is impractical, appropriate eye protection for the laser wavelength must be worn by all for all operator(s), maintenance workers, spectators and service personnel when the laser system is engaged.
5. Skin Protection – Skin protection should be worn as indicated by the laser manufacturer. A standard surgical glove will usually provide adequate protection in the far UV. Tightly woven fabrics and other materials may be necessary in the UV-A. A surgical gown can provide protection for the arms. Consideration should be given to fire retardant material when a fire hazard exists.
6. Area Signage – areas in which Class 4 lasers are used require a "Danger" area warning sign located at the entrance to the area where each laser system is located. See Appendix B for label example of signage.
7. Medical Examinations – University employees who are operators, maintenance, or service personnel for Class 4 lasers should receive a medical examination prior to participation in laser work or following any suspected laser injury consisting of ocular history and visual acuity. See section IX. D *Medical Facility Arrangements* for the recommended facility for each campus.
 - a. If the ocular history shows no problems and visual acuity is found to be

- 20/20 (6/6/ in each eye for far, and Jaeger 1+ for near) with corrections (whether worn or not) and Amsler Grid Test and Color Vision responses are normal, no further examination is required.
- b. Any deviations from acceptable performance will require an identification of the underlying pathology either by fundoscopic examination, or other tests as determined appropriate by the responsible medical or optometric examiner.
8. Service Access Panels – Class 4 laser service access panels must be:
 - a. have a warning label attached to the panel, and
 - b. be interlocked or require a tool for removal.
 9. Key Control – All Class 4 laser should be provided with a master switch which terminates the beam or shuts off the system. This master switch should be operated by a key or by coded access (such as a computer code).
 10. Activation Warning System – Class 4 lasers must have a red or blue warning light that flashes when the laser system is operating. These lights must be installed at the entrance to the laser area and be visible within the laser area itself.
 11. Indoor Laser Controlled Area – All Class 4 lasers must have a laser controlled area which:
 - a. is located so that access to the area by spectators is limited and entry approval is required from the LSC;
 - b. has any potentially hazardous beam terminated with a beam stop;
 - c. has only diffusely reflecting material in or near the beam path;
 - d. requires personnel within the laser controlled area to wear the appropriate eye protection;
 - e. ensures that the laser is secured such that the beam path is above or below eye level of a person in the standing or seated position;
 - f. has all windows and doorways from an indoor facility either covered or restricted in such a manner as to reduce the transmitted laser light to below the MPE;
 - g. has a red mushroom type panic button clearly marked as “Laser Emergency Shutdown” for emergency conditions; and
 - h. uses blocking barriers, screens, or curtains to block or screen the laser radiation at the entryway.
 12. Outdoor Hazard Evaluation – Class 4 lasers require that an outdoor hazard evaluation be performed by the LSO/ALSO to include but not limited to:
 - a. an evaluation of the engineering controls,
 - b. establishing the NHZ,

- c. identifying personal protective equipment to be used within the NHZ, and
- d. incorporating these requirements into the SOPs.

In addition, the SOPs should reflect that the NHZ is to be clearly posted with laser warning signs and that all personnel authorized to enter the NHZ are appropriately trained in the requirements of Class 3b lasers. See Section VII. B for additional requirements for outdoor use.

- 13. Interlocks on Protective Housing – Class 4 lasers require a protective housing interlock which should not be defeated or overridden during operation unless recommended control measures are adhered to. Adjustments or procedures during service on lasers or laser systems containing interlocks should not cause the interlocks to be inoperative when the equipment is restored.
- 14. Unattended Laser Operation – Class 4 lasers should be used for unattended operation in unsupervised areas only when:
 - a. the LSO/ALSO has implemented control measures that provide adequate protection and laser safety training for those who may enter the laser controlled area during times of unattended use, and
 - b. all areas where unattended Class 4 lasers operate have “Danger” laser safety warning signs (see Appendix B) posted along with instructions on the hazards of entry into the space when no operator is present.

VII. ADDITIONAL SPECIAL SAFETY REQUIREMENTS

A. LASERS IN HEALTH CARE FACILITIES

Lasers in health care facilities present some unique challenges which must be incorporated by the LSC for the area within his/her area of responsibility within the SOPs for Class 3b or Class 4 laser systems.

1. Protective Equipment

All protective equipment for Health Care Laser Systems (HCLS) should be in accordance with ANSI Z136.1. Accessory attachments to HCLS (e.g., handpieces, laparoscopes, endoscopes, fibers, remote controls, scanners, etc.) should be compatible with and provide prerequisite laser safety. Laser filters placed in operating microscopes should protect the surgeon at the main binocular viewing tube, and any assistants or observers using accessory viewing optics.

2. Patient Eye Protection

- a. The LSC must complete a hazard analysis for each procedure involving a Class 3b or a Class 4 laser. When the patient’s eyes are within the NHZ, they should be protected by a method approved by the LSO such as with wet

eye pads, laser protective eyewear, or other appropriate methodology, i.e., laser specific eye shields.

- b. When facial area, particularly around the eyes are being treated, (e.g., for port wine stains or neoplasia) protective glasses may not be appropriate to shield the patient's eyes. For treatments on or near the eyelids, appropriate corneal shields should be used.

3. Eyewear for Fiberoptic Procedures

Fibers may break or may become disconnected during surgical procedures resulting in an ocular hazard. Therefore, if deemed appropriate by the LSO/ALSO, the laser controlled area may be designated as the entire operating room, even if the laser output was restricted to the body cavity by an endoscope or other devices. All involved personnel within the laser controlled area during such procedures should wear protective eyewear.

4. Laser Generated Airborne Contaminants (LGAC)

Operations that use Class 3b lasers with focused beams (high irradiance) or Class 4 lasers may produce laser generated airborne contaminants (LGACs). Some examples of LGACs, and the protective requirements, are presented here.

a. Bloodborne Pathogens

LGACs can contain blood and blood by-products. Laser users need to be aware of the potential for such products during any medical/surgical procedures and utilize control measures such as universal precautions as addressed by the OUHSC/OU-Tulsa *Infectious Diseases Policy* and the OU *Bloodborne Pathogen Policy*.

b. Room Exhaust Ventilation

Airborne contaminants should be controlled by the use of ventilation and respiratory protection. The primary measure to control LGAC in health care facilities for purposes of this program should be local exhaust ventilation. Local exhaust ventilation is used to capture airborne contaminants as near as practical to the point of evolution (without altering surgical effectiveness) to produce an effective removal rate for LGAC.

The LGAC should be captured as near as practical to the point of production and either be completely trapped within the system or vented out of the area. It should not be recirculated.

5. Fire and Explosion Hazards

Fire hazards associated with lasers take many forms. The most obvious is the use of flammable liquids. Oxidizing gases can also pose significant fire hazards. Not so obvious are

the materials used in constructing the laser such as plastic parts and tubing that can enhance the spread of fire. Failure of electrical equipment is always a hazard as a potential source of ignition. While these forms of fire occur outside of the patient, it has to also be realized that fires can be created in patients undergoing laser surgical procedures due to the laser beam interacting with some material (i.e., methane gas in bowels, plastic tubing introduced into the airway).

Rooms where laser surgical procedures are performed should be equipped with a operational and prominently located portable fire extinguisher.

6. Endotracheal Tube Fires

When performing airway laser surgery in the presence of endotracheal tubes, the tube should have protection or special design to avoid the potential for fire. Fire hazards related to endotracheal tubes, plastic, plastic adhesive tape, ointment, and surgical preparatory solutions can be controlled by such methods as use of non-combustible instrumentation, Venturi ventilation technique, shielding and wet substrates and use of low-combustion gas (Helox) mixtures. Anesthesia personnel should use nonflammable, specially wrapped or chemically treated (silicone) laser resistant tubes. Plastics and armored or wire tubes are particularly hazardous. FDA-approved endotracheal tubes and endotracheal tube wrapping material exist and should be used when endotracheal anesthesia is the preferred method. Polyvinyl chloride tubes should not be used, either wrapped or unwrapped. The endotracheal tube cuffs should be inflated with liquid and externally protected with wet cottonoids.

Since combustion may be initiated in the aerodigestive tract in high oxygen saturation or in the presence of flammable gases (e.g. methane), then the lowest possible concentration of oxygen should be used in laryngeal-tracheal procedures, and adequate exhaust ventilation should be provided in colonic procedures.

The use of intravenous anesthetic techniques, in lieu of inhalation techniques, is recommended to prevent laser pyrolysis of gaseous anesthetic agents or build up of concentrations supporting combustion. Noncombustible anesthetic agents and localized ventilation techniques are mandated.

B. LASERS USED OUTDOORS

1. Before Class 3b and Class 4 lasers are used in airspace, the department should apply for and receive a variance from the Food and Drug Administration's Center for Devices and Radiological Health (FDA/CDRH).
2. Before any Class 3b, or Class 4 laser is used around any navigable airspace, the LSO/ALSO should determine whether such use will be within any critical zone (see Appendix A for definitions). If so, a variance is required from the FAA before any operations may begin.

VIII. EQUIPMENT ACQUISITION, SURPLUS

Departmental LSCs should notify the LSO/ALSO of any acquisition, disposal, or surplus of any Class 3b or Class 4 laser or laser system.

IX. MEDICAL EXAMINATIONS/MEDICAL TREATMENT

- A. All occupational accidents, injuries or exposures associated with laser systems, including minor injuries requiring first aid, should be reported to the employee's supervisor and/or LSC who should secure appropriate medical attention for the employee (see IX.C. below for recommended locations).
 - 1. For all such incidents, the immediate supervisor is responsible for completing and signing a *Form 2 Employer's First Notice of Injury* form and a *Supervisor's Report of an Occupational Injury or Illness*. The employee should complete an *Employee's Report of Injury On The Job* form.
 - 2. All three completed forms should be faxed to the workers' compensation insurance carrier within 24 hours of the incident. Copies of exposure report forms and FAX information for the insurance carrier are available from the Human Resources Department for Tulsa and Oklahoma City campuses, and Risk Management on the Norman campus.
- B. It is the responsibility of the department to schedule and pay for appropriate medical examinations as required by this program.
- C. Recommended facilities for medical examinations or medical treatment under this program are as follows:
 - 1. Norman Campus

Goddard Health Center
620 Elm Avenue
Norman, Oklahoma 73019-2091
Phone (405) 325-4611
 - 2. OUHSC

Employee Health
Family Medicine Center Green Clinic
900 NE 10th Street
Oklahoma City, OK 73190
Phone (405) 271 3100

3. OU-Tulsa

MedCenter Immediate Care
2929 South Garnett
Tulsa, Oklahoma 74129
Phone (918) 665-1520

X. RECORD RETENTION

All appropriate records in this program will be made maintained and made available to qualified persons or agencies as specified in 29 CFR 1910.1020 or 29 CFR 1926.33, *Access to Employee Exposure and Medical Records*.

A. MEDICAL RECORDS

Appropriate medical records required by this program will be maintained by the healthcare facility providing the medical examination or medical treatment.

B. TRAINING RECORDS

1. The EHSO will maintain training records required by this program consisting of at least:
 - a. employee name,
 - b. department,
 - c. date of training,
 - d. type and class of laser, and
 - e. a unique employee identifier such as userid or employee number.
2. Training records will be maintained for at least three (3) years after the date of last employment.

APPENDIX A
DEFINITIONS

DEFINITIONS

Accessible emission limit (AEL) – The maximum accessible emission level permitted within a particular class of laser.

Accessible radiation – Radiation to which it is possible for the human eye or skin to be exposed to in normal usage.

Afterimage – A transient image left in the visual field after an exposure to a bright light.

Aversion response – Closure of the eyelid, or movement of the head to avoid an exposure to a noxious stimulant or bright light. In accordance with ANSI Z136.6 – 2000, the aversion response is assumed to occur within 0.25 s, including blink reflex time.

Beam backstop – A non-specular material that is opaque to laser radiation of a particular wavelength. An adequate backstop encompasses the entire laser beam and appropriate buffer area.

Construction Laser – A laser product used outdoors and intended for surveying, leveling, or alignment. Class 1, Class 2, and Class 3a lasers are usually used for these purposes.

Continuous wave (cw) – The output of a laser which is operated in a continuous rather than a pulsed mode. A laser operating with a continuous output for a period greater than 0.25 seconds is regarded as a cw laser.

Critical zone – Volume of airspace where visual interference by a visible laser beam would compromise safety due to interruption of necessary performance of critical tasks. This zone surrounds the laser-free zone.

Diffuse reflection – Change of the spatial distribution of a beam of radiation when it is reflected in many directions by a surface or by a medium.

Embedded laser – A laser with an assigned class number higher than the inherent capability of the laser system in which it is incorporated, where the systems lower classification is the result of engineering features which limits the accessible emissions.

Flash blindness – A visual interference effect that persists after the source of illumination has been removed.

Flight hazard zone – The flight hazard zone describes the space within which the level of radiation during operation exceeds the applicable exposure level. This includes: nominal hazard zone (NHZ), critical zone, and laser-free zone.

Health Care Laser System – (HCLS) Laser systems used in health care applications, and includes a delivery system to direct the output of the laser, a power supply with control and calibration functions, mechanical housing with interlocks, and associated fluids and gases required for the operation of the laser.

Health Care Personnel – (HCP) Individuals directly involved with patient care.

Infrared radiation – Optical radiation with wavelengths greater than that defined as visible radiation, i.e., greater than 0.78 μm .

Interaction Area – The area in which irradiation of materials by the primary or secondary beam occurs.

Invisible laser – An invisible laser emits a wavelength outside the spectral range defined as visible radiation, i.e., outside of the wavelength range of 0.39 to 0.78 μm . This term means that the laser beam cannot be seen.

Laser – A device that produces an intense, coherent, directional beam of light by stimulating electronic or molecular transitions to lower energy levels. An acronym for Light Amplification by Stimulated Emission of Radiation.

Laser Classification – Laser classification should be based on the maximum output available for the intended use.

Laser-free level – The maximum level of visible optical radiation which is not expected to cause any visual interference to an individual performing critical tasks.

Laser-free zone – A designated area or volume of airspace where any extraneous visible optical radiation could interfere with safety.

Laser Hazard Classification

Class 1: Cannot emit laser radiation at known hazard levels (typically 0.4 micro watts (μW) as visible wavelengths.) Users of Class 1 laser products are exempt from radiation hazard controls during operation and maintenance. Class 1 lasers are considered to be incapable of producing damaging levels of laser emission

Class 2: Low power visible laser, which emit above a Class 1 levels but emitting a radiant power not above 1 milliwatt (mW). Class 2 applies only to visible laser emissions which may be viewed only for time periods less than or equal to 0.25 seconds.

Class 2a: is a special designation that is based upon a 1000 second exposure and applies only to lasers that are “not intended for viewing” such as a supermarket laser scanner. The upper power limit of Class 2a is 4.0 μW .

Class 3a: Intermediate power laser (cw: 1-5 mW). Only hazardous for intra-beam viewing

Class 3b: Moderate power lasers (cw: 5-500 mW, pulsed: 10 J/cm² - or the diffuse reflection limit, whichever is lower) Class 3b lasers will not be a fire hazard nor are not generally capable of producing a hazardous diffuse reflection except for conditions on intentional staring done at distances close to the diffuser. Lower-power Class 3b lasers are those that do not exceed the Class 3a AEL by more than 5 times.

Class 4: High power lasers (cw: 500 mW) are hazardous to view under any condition (directly or

diffusely scattered) and are a potential fire hazard and a skin hazard.

Laser Radiation – Laser radiation as defined herein refers to the ultraviolet, visible, and infrared regions of the electromagnetic spectrum and should not be confused with ionizing radiation.

Laser User – should include operators, technicians, engineers, maintenance and service personnel working with or around lasers or laser systems.

Maximum Permissible Exposure (MPE) The level of laser radiation to which a person may be exposed without hazardous effect or adverse biological changes in the eye or skin. See Appendix C for tables of MPE.

Navigable airspace – Airspace that can contain aircraft. As defined in ANSI Z136.6– 2000, navigable airspace is defined as airspace that is 500 feet (153 m) from any structure in semi-populated areas. In heavily populated areas, aircraft are required to allow more distance from structures. Near airports or heliports, navigable airspace extends to the runway. helicopter operations may require additional considerations since they are often flying below 500 feet.

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 Maximum Permissible Exposure (MPE).

Outdoor – As defined in ANSI Z136.6–2000, a location for a laser where the insertion of a mirror into the output beam path could create a specular reflection that extends indefinitely. However, if the reflected beam thus created does not exceed the MPE anywhere along the beam path, or one of the visual interference levels within the corresponding visual interference zone, the location need not be considered as outdoors.

APPENDIX B
EXPOSURE TABLES

Table B-1 Maximum Permissible Exposure (MPE) for Selected Lasers.

Laser Type	Wavelength (nm)	0.25 ^(b)	Exposure Time ^(seconds)		
			10 ^(c)	600 ^(d)	3000 ^(e)
		MPE (mW x cm ⁻²)			
ArF	193	–	–	–	0.0001
XeCl	308	–	–	–	0.0013
XeF	351	–	–	–	0.0333
Argon	514	2.5	–	0.0167	0.001
Krypton	530	2.5	–	0.0167	0.001
	568	2.5	–	0.031	0.00186
	647	2.5	–	0.363	0.0285
He-Ne	633	2.5	–	0.293	0.0176
GaAs (CW) (diode)	840	–	1.9	0.69	0.610
Nd:YAG Q-switched (a)	1064	–	0.017	0.0061	0.0023
Nd:YAG (CW)	1064	–	5.1	1.82	1.6
Nd:YAG (CW)	1330	–	40	14.5	13
CO ₂	10600	–	100	100	100

- (A) Repetitively pulsed @ 11 Hz, 12 ns pulses.
- (B) Aversion response time.
- (C) Unintentional viewing at wavelengths greater than 700 nm, with no visible component.
- (D) Intentional viewing of diffuse reflections from small sources (less than ∞_{\min}).
- (E) Cumulative exposure, 8 hour working day.

Table B-2. Selected MPEs. Values are for selected wavelengths for exposure durations usually less than 10 seconds.

Wavelength (μm)	Exposed Duration (s)	MPE	
		Pulsed (J·cm ⁻²)	CW (W·cm ⁻²)
0.180 to 0.302 * 0.302 to 0.315 *+ 0.315 to 0.400	10 ⁻⁹ to 3x10 ⁴ 10 ⁻⁹ to 3x10 ⁴ 10 ⁻⁹ to 10	3x10 ⁻³ 0.63x(λ/0.314) ^{1.42} 0.56xt ^{0.25}	3x10 ⁻³ xT _{max} ⁻¹ 0.63x(λ/0.314) ^{1.42} xT _{max} ⁻¹ 0.56xT _{max} ^{-0.75}
0.4000 to 1.050	10 ⁻¹³ to 10 ⁻¹¹ 10 ⁻¹¹ to 10 ⁻⁹ 10 ⁻⁹ to 18x10 ⁻⁶ 18x10 ⁻⁶ to 10 0.25 10	1.5xC _A x10 ⁻⁸ 2.7xC _A xt ^{0.75} 0.5xC _A x10 ⁻⁶ 1.8xC _A xt ^{0.75} x10 ⁻³ 0.64xC _A x10 ⁻³ 10xC _A x10 ⁻³	1.8xC _A xT _{max} ^{-0.25} x10 ⁻³ 2.6xC _A x10 ⁻³ 1.0xC _A x10 ⁻³
1.050 to 1.400	10 ⁻¹³ to 10 ⁻¹¹ 10 ⁻¹¹ to 10 ⁻⁹ 10 ⁻⁹ to 50x10 ⁻⁶ 50x10 ⁻⁶ to 10 10	1.5xC _C x10 ⁻⁷ 27xC _C xt ^{0.75} 5.0xC _C x10 ⁻⁶ 9xC _C xt ^{0.75} x10 ⁻³ 50xC _C x10 ⁻³	9xC _C xT _{max} ^{-0.25} x10 ⁻³ 5xC _C x10 ⁻³
1.400 to 1.500	10 ⁻⁹ to 10 ⁻³ 10 ⁻³ to 10 10	0.1 0.56xt ^{0.25} 1.0	1/(10xT _{max}) 0.56xT _{max} ^{-0.75} 0.1
1.500 to 1.800	10 ⁻⁹ to 10 10	1.0 1.0	1/T _{max} 0.1
1.800 to 2.600	10 ⁻⁹ to 10 ⁻³ 10 ⁻³ to 10 10	0.1 0.56xt ^{0.25} 1.0	1/(10xT _{max}) 0.56xT _{max} ^{-0.75} 0.1
2.600 to 10 ³	10 ⁻⁹ to 10 ⁻⁷ 10 ⁻⁷ to 10 10	10x10 ⁻³ 0.56xt ^{0.25} 1.0	0.56xT _{max} ^{-0.75} 0.1

* For the wavelength band of 0.18 to 0.314 μm, the exposure is considered photochemical and additive over a full day of exposure. In addition, the MPE has a thermal limit of 0.56xt^{0.25}, which must be checked for pulsed laser. The pulse correction factor, C_p is applied to the thermal limit, but not to the photochemical limit.

+ For the wavelength band of 0.303 to 0.314 μm, the computed values given by the equation are only approximate. See ANSI z136.1-2000 for exact values.

$$C_A = 1.0 \text{ for } \lambda = 0.4 \text{ to } 0.7 \text{ } \mu\text{m} \quad C_A = 10^{2(\lambda-0.7)} \text{ for } \lambda = 0.7 \text{ to } 1.05 \text{ } \mu\text{m} \quad C_A = 5.0 \text{ for } \lambda = 1.05 \text{ to } 1.4 \text{ } \mu\text{m}$$

$$C_C = 1.0 \text{ for } \lambda = 1.05 \text{ to } 1.15 \text{ } \mu\text{m} \quad C_C = 10^{18(\lambda-1.15)} \text{ for } \lambda = 1.15 \text{ to } 1.2 \text{ } \mu\text{m} \quad C_C = 8.0 \text{ for } \lambda = 1.2 \text{ to } 1.4 \text{ } \mu\text{m}$$

C_E should be applied to both the pulsed and CW thermal MPE for the retinal hazard region.

C_p should be applied to the MPE for repetitive-pulse lasers.

Table B-3. Limiting and Measurement Apertures.

WAVELENGTH (μm)	T_{max} or t (s)	D_f^* UNAIDED (mm)	D_c^+ AIDED (mm)	TRANSMISSION OF OPTICS (%)	D_c & D_f SKIN (mm)
0.180 - 0.302	10^{-9} - 0.3	1.0	N/A	0	3.5
	0.3 - 10	$1.5t^{0.375}$	N/A	0	3.5
	10 - 30k	3.5	N/A	0	3.5
0.303 - 0.400	10^{-9} - 0.3	1.0	7.0	70	3.5
	0.3 - 10	$1.5t^{0.375}$	$11t^{0.375}$	70	3.5
	10 - 30k	3.5	25	70	3.5
0.400 - 0.700	10^{-13} - 30k	7.0	50	90	3.5
0.700 - 1.400	10^{-13} - 30k	7.0	50	70	3.5
1.400 - 2.800	10^{-9} - 0.3	1.0	7.0	70	3.5
	0.3 - 10	$1.5t^{0.375}$	$11.0t^{0.375}$	70	3.5
	10 - 30k	3.5	25	70	3.5
2.800 - 10^3	10^{-9} - 0.3	1.0	N/A	0	3.5
	0.3 - 10	$1.5t^{0.375}$	N/A	0	3.5
10^3 - 10^5	10 - 30k	3.5	N/A	0	3.5
	10^{-9} - 30k	11.0	N/A	0	11.0

* The limiting aperture is the smallest aperture for which irradiance and radiant exposure should be averaged over, when compared to MPE values. For unaided viewing, these apertures are applied to measure or calculated values.

+ For optically aided viewing, a 7-power optical system is usually assumed for a hazard evaluation. An ideal pair of 7x50 binoculars would have a 50 mm entrance aperture and a 7 mm exit aperture, which results in about 7.14 magnifying power. Therefore, the measurement apertures listed in this column are 7 times those of the previous column for those wavelengths expected to transmit laser energy.

‡ When measurement apertures are larger than the limiting aperture due to the possibility of magnifying optics being used, the measured or calculated irradiance or radiant exposure is multiplied by reasonable transmission value such as that listed in this column.

Table C-4. Visual Interference Levels.*

Flight Zone or Region of Visual Interference	Visual Interference Levels		
	Effective Radiant Exposure (J·cm ⁻²) ⁺ T _{max} ≤ 0.25 s	Effective Irradiance (W·cm ⁻²) ⁺ T _{max} > 0.25 s	Illuminance (lm·cm ⁻²) T _{max} > 0.25 s
Normal	1.8x10 ⁻³ xT _{max} ^{0.75}	2.5x10 ⁻³	1.7 (for 0.55 μm only)‡
Sensitive	25x10 ⁻⁶	100x10 ⁻⁶	6.8x10 ⁻²
Critical	1.25x10 ⁻⁶	5.0x10 ⁻⁶	3.4x10 ⁻³
Laser-Free	1.25x10 ⁻⁹	50x10 ⁻⁹	3.4x10 ⁻⁵

* Interm levels are listed from visible lasers used at dusk or night. The values in this table are based on preliminary perceptions and accepted practice at this time. Future research on visual interference effects may result in a modification of these levels.

+ Measured (or calculated) irradiance levels must be multiplied by the photopic luminance efficiency coefficient obtained from table 5 in order to correct for visual sensitivity of the human eye. The irradiance levels for the normal region are not corrected for visual effect using V(λ) since these levels correspond to the MPE. The formula provides MPE values for exposure durations from 18 μs to 0.25 s. Whenever the irradiance exceeds the MPE, the MPE takes precedence even if the visual interference level is higher.

‡ The normal region is limited by the MPE, which is not wavelength dependent in the visible spectrum. The MPE expressed as actual irradiance or radiant exposure is applicable for this region. The listed value for illuminance is only for a laser with a wavelength of 0.55 μm. The visual interference level for other wavelengths may be calculated by multiplying the provided value by v(λ) from table 5.

Table C-5. Photopic Luminous Efficiency Function $V(\lambda)$.

Laser Wavelength (μm)	$V(\lambda)$	Laser Wavelength (μm)	$V(\lambda)$
0.380	0.00004	0.585	0.810
0.385	0.00007	0.590	0.758
0.390	0.00012	0.595	0.710
0.395	0.00018	0.600	0.633
0.400	0.00040	0.605	0.580
0.405	0.00058	0.610	0.503
0.410	0.0012	0.615	0.450
0.415	0.0020	0.620	0.382
0.420	0.0040	0.625	0.325
0.425	0.0065	0.630	0.265
0.430	0.0116	0.635	0.215
0.435	0.0170	0.640	0.175
0.440	0.0230	0.645	0.132
0.445	0.0300	0.650	0.107
0.450	0.0380	0.655	0.0750
0.455	0.0500	0.660	0.0610
0.460	0.0599	0.665	0.0435
0.465	0.0720	0.670	0.0321
0.470	0.0909	0.675	0.0225
0.475	0.105	0.680	0.0170
0.480	0.139	0.685	0.0106
0.485	0.162	0.690	0.0082
0.490	0.208	0.695	0.0059
0.495	0.250	0.700	0.0041
0.500	0.323	0.705	0.0030
0.505	0.400	0.710	0.0021
0.510	0.503	0.715	0.0014
0.515	0.620	0.720	0.0010
0.520	0.709	0.725	0.00077
0.525	0.800	0.730	0.00052
0.530	0.862	0.735	0.00035
0.535	0.925	0.740	0.00025
0.540	0.954	0.745	0.00018
0.545	0.980	0.750	0.00012
0.550	0.990	0.755	0.000085
0.555	1.000	0.760	0.000060
0.560	0.990	0.765	0.000042
0.565	0.970	0.770	0.000030
0.570	0.952	0.775	0.000020
0.575	0.910	0.780	0.000015
0.580	0.870		

* The listed CIE normalized photopic luminous efficiency function $V(\lambda)$ is photopic for the standard observer. The illuminance ($\text{lm}\cdot\text{cm}^{-2}$) is the measured irradiance multiplied by $V(\lambda)$ and 683. The effective irradiance ($\text{W}\cdot\text{cm}^{-2}$) is the actual (measured) irradiance multiplied by $V(\lambda)$.

Table B-6 Skin MPEs. *

Wavelength (μm)	Exposure Duration (s)	MPE	
		Pulsed ($\text{J}\cdot\text{cm}^{-2}$)	CW ($\text{W}\cdot\text{cm}^{-2}$)
0.180 to 0.314	10^{-9} to 3×10^4	Same as Table 2	Same as Table 2
0.315 to 0.400	10^{-9} to 10	$0.56xt^{0.25}$	$0.56xT_{\text{max}}^{-0.75}$
0.400 to 1.400	10^{-9} to 10^{-7}	$0.2xC_A \times 10^{-3}$	$1.1xC_A \times T_{\text{max}}^{-0.75}$
	10^{-7} to 10	$1.1xC_A \times t^{0.25}$	$0.2xC_A$
1.400 to 1.0×10^3	10	$2.0xC_A$	See Table 2
	10^{-9} to 10	See Table 2	

***Values are for selected wavelengths for exposure durations less than 10 s (except for UV)**

Table B-7 NHZ Distances for Selected Lasers.

Laser Type	MPE Exposure Time Criteria (s)	NHZ (m)		
		Diffuse ^(a)	Laser with Lens ^(b)	Laser without Lens
CW Visible ^(c) 400 – 700 nm	0.25	NONE	33.6	500
CW Nd: YAG 1064 nm	10	0.79	6.37	790
CW CO ₂ 10600 nm	10	0.18	2.38	178
Q-SW Nd:YAG 1064 nm	1–20 x 10^{-9}	NONE	0.45	226

- (a) Worst case reflection ($\rho = 1$) and worst case viewing angle ($\cos = 1$) prevail, viewing distance >20 cm.
- (b) Distance from focus.
- (c) HeNe, Argon, etc.

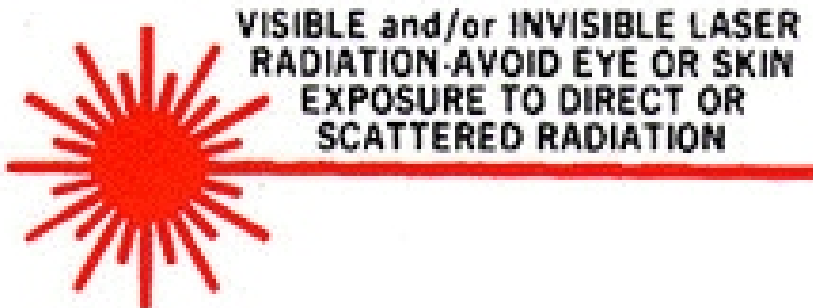
Table B-8 Laser criteria used for NHZ distance calculations.

Laser Parameter	CW Visible	CW Nd:YAG	CW CO ₂	Q-SW ^(a) Nd:YAG
Wavelength (nm)	400–700	1064	10600	1064
Beam power (W)	5	100	100	–
Beam energy (mJ)	–	–	–	2
Beam divergence (mrad)	1	2	2	1
Beam size aperture (mm)	2	2	20	25
Beam size at lens (mm)	3	6.3	30	25
Lens focal length (mm)	200	25.4	200	50
MPE ($\mu\text{W}/\text{cm}^2$)@ 10 s	–	5.1×10^3	1.0×10^5	–
MPE ($\mu\text{W}/\text{cm}^2$)@ 0.25 s	2.5×10^3	–	–	–
MPE ($\mu\text{J}/\text{cm}^2$)@ 1–20 ns	—	–	–	5

(a) Typical for ophthalmological use

APPENDIX C
LASER SIGNAGE

LASER SIGNAGE

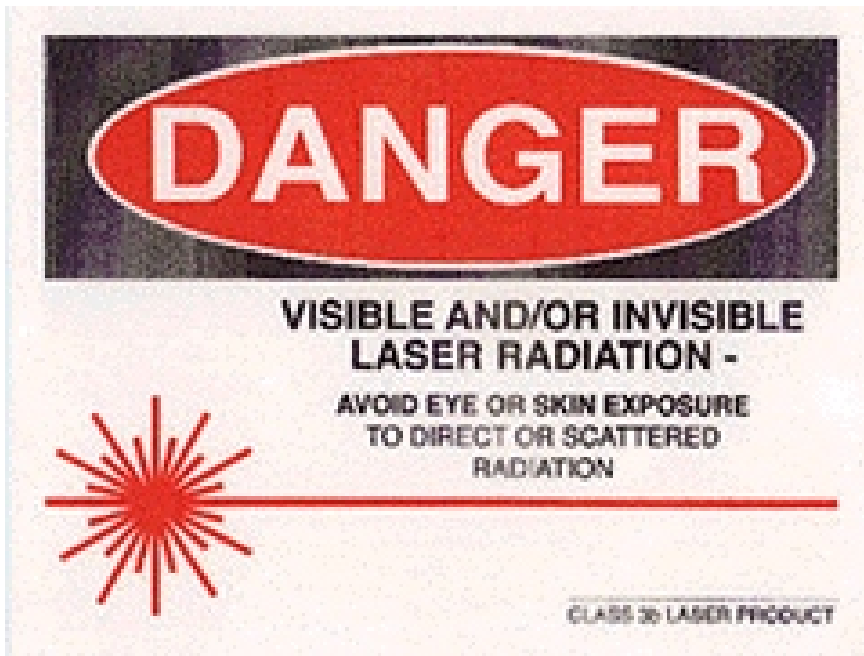


CLASS IV LASER PRODUCT

Class 4 Laser



Class 3a Laser



Class 3b Laser



Temporary Signage

APPENDIX D
LASER SURVEY FORM

APPENDIX E
CURRENTLY INSTALLED LASER SYSTEMS

CURRENTLY INSTALLED LASER SYSTEMS

I. OU NORMAN

(To be completed)

II. OUHSC LASER SYSTEMS

(To be completed)

III. OU-TULSA LASER SYSTEMS

A. Tulsa Women's Clinic – 2815 S. Sheridan

1. Room 139

- a. Laser Industries Inc
Sharplan Laser Model 1020, Serial number 20-002AB
Max output CO₂ 30W, He-Ne 2mW
Class IV

B. Surgery Department – Schusterman Center

1. Room 2E11

- a. Coherent
Model Entcii-621, Serial number 33132-ENT
Max output Ar 2W
Class IV
- b. Spectra-physics Laser
Model 163-A1202, Serial number PO194790
Max output 200 mW @ 454 to 676 nm
Class 3 – Embedded laser

2. Room 2E15

- a. Fluorescent Image Analyzer
Model FLA-3000
SHG laser Max output 2 mW @ 473 nm
Class 3 – Embedded laser
He-Ne laser Max output 17 mW @ 632.8 nm
Class 3 – Embedded laser

C. Urban Design Studio

1. Building 9 Room 900A
 - a. Universal Laser Systems
V-400 Laser Platform
Max output CO₂ 4 mW @ 630-689 nm
Class 3 – Embedded laser