



NORTHERN ARIZONA UNIVERSITY

Laser Safety Manual

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Scope and Applicability

This manual applies to all personnel working at or visiting Northern Arizona University (NAU) who procure or utilize Class III and Class IV lasers and laser systems.

Procurement and use of Class I and Class II laser equipment, such as low power laser pointers and compact disk players, do not normally need to comply with the provisions of the manual. Pointers over 5mW are illegal and their purchase/use is prohibited. Any servicing, modification, or other manipulation of Class I and Class II systems resulting in access to laser radiation from embedded Class III and Class IV (as defined in Section III below) does fall within the scope of this manual. Under these conditions the lasers will need to be registered, users trained, and appropriate control measures employed.

NAU procures and uses lasers and laser containing equipment under regulations issued by the Arizona Radiation Regulatory Agency (ARRA). Use of this equipment at NAU is subject to inspection and review by personnel from ARRA. In order to ensure compliance with Arizona regulations for the control of laser radiation, it is essential that NAU personnel and vendors understand and follow provisions of this manual.

SECTION I - Overview of Safety Requirements for Lasers

1.1 Registration

Class IIIb and IV Lasers and laser systems must be registered with the NAU Environmental Health and Safety (EH&S) department. The registrant must be a full time faculty or staff member at NAU who bears overall responsibility for safe use of registered equipment. New equipment must be registered prior to operation. Class IIIb and IV Lasers and laser systems brought to NAU must be registered with EH&S also.

1.2 Laser Classification

Lasers at NAU must be classified in accordance with provisions of Section 3 of this document. Lasers purchased commercially may retain the classification provided by manufacturers in compliance with requirements of the Federal Laser Product Performance Standard provided modifications altering the classification have not been made. Modified lasers, or lasers constructed on site, must be classified by the Laser Safety Officer (LSO).

1.3 Training

All individuals operating Class IIIb and Class IV lasers or laser systems must obtain training on the hazards associated with the equipment and proper safety control measures. This training must be documented and copies of the documentation filed with the EH&S Laser Safety Program.

1.4 Safety Control Measures

Class IIIb and Class IV lasers or laser systems must be operated under administrative and/or engineering control measures which have been approved by the LSO prior to operation. These measures might include written procedures for operation and/or laser servicing.

1.5 Laser Surveys

Periodic (semi-annual in most cases) safety surveys of lasers and laser control measures will be made by EH&S.

1.6 Exemption of Class I, Class II and Class IIIa Lasers

Class I, II, and IIIa lasers or laser systems are exempt from all requirements of this manual. Class IIIb or IV lasers are usually embedded in devices of a lower class, however. Modification or service of Class I or II or IIIa lasers or laser devices which results in access to laser radiation of a higher class laser shall require compliance with requirements for the embedded lasers.

SECTION II - Laser Safety Organization at NAU

2.1 Arizona Radiation Regulatory Agency (ARRA)

NAU procures and uses Lasers and Laser Systems under regulations of ARRA. The regulations require that NAU personnel use ARRA approved procedures for the control of all lasers. ARRA also requires that Class IIIb and IV lasers be registered with that agency.

NAU is subject to inspection by ARRA. If ARRA finds that NAU is not in compliance with state regulations, they may issue fines, or in the case of serious infractions, suspend or revoke individual or institutional eligibility for laser use. ARRA Rules and Regulations, and supporting documentation are on file for review by NAU personnel in the Environmental Health and Safety.

2.2 Laser Safety Officer

The LSO is supported by the staff of the Environmental Health and Safety Office. Specific responsibilities and services offered by the Laser Safety Officer include the following:

2.2.1 Classification

The LSO will classify, or verify classifications of lasers and laser systems used at NAU.

2.2.2 Hazard Evaluation

The LSO is responsible for hazard evaluation of laser work areas.

2.2.3 Control Measures

The LSO is responsible for assuring that the prescribed control measures are in effect, recommending or approving substitute or alternate control measures when the primary ones are not feasible or practical, and periodically auditing the status of those control measures in use.

2.2.4 Procedure Approvals

The LSO approves standard operating procedures, alignment procedures, and other procedures that may be part of the requirements for administrative and procedural control measures.

2.2.5 Protective Equipment

The LSO recommends or approves protective equipment i.e., eye wear, clothing, barriers, screens, etc., as may be required to assure personnel safety. The LSO assures that protective equipment is audited periodically to ensure proper working order.

2.2.6 Signs and Labels

The LSO approves the wording on area signs and equipment labels.

2.2.7 Facility and Equipment

The LSO approves laser installation facilities and laser equipment prior to use. This also applies to modification of existing facilities or equipment.

2.2.8 Authority

The LSO has the authority to suspend, restrict, or terminate the operation of a laser or laser system if he/she deems that laser hazard controls are inadequate. The actions of the LSO are reviewed by the Radiation Safety Committee.

2.3 Registrant

Each Class IIIb or Class IV laser or laser system at NAU must be registered with EH&S, which in turn registers these devices with ARRA as required under Arizona law. Each laser or laser system must be registered to a faculty or staff member of NAU who maintains responsibility for all aspects of laser safety for the registered equipment. Responsibilities of the registrant include:

2.3.1 Registration

The registrant must register new equipment with the EH&S within 30 days of receipt and prior to operation of new laser equipment.

2.3.2 Training

The registrant must ensure that laser personnel including operators of laser equipment and selected incidental personnel are properly trained with respect to safe operation and made aware of laser hazards associated with the laser equipment.

2.3.3 Eye Exam

The registrant should ensure laser personnel and incidental personnel obtain a pre assignment laser eye exam. Registrants may contact their academic unit safety representative or the EH&S office for further information.

The ANSI Z136.1, 1993 protocol for the pre assignment eye examination for laser personnel includes:

- Ocular history for previous eye injuries and illness.
- Visual Acuity test.
- Grid test (Amsler or equivalent)
- Color Vision test.

The ANSI Z136.1 requirement for authorized incidental personnel is only a baseline visual acuity test.

Laser eye examinations would be required in event of an actual or suspected laser eye injury. An appropriate eye examination would be required in the event an individual transfers out of the laser control area or terminates. Examinations are not required on a periodic basis. Examinations are required when personnel transfer to a non laser control area or terminate from the university.

Determination of the need for additional examinations are at the discretion of the physician/or qualified medical authority.

Additional details for these responsibilities may be found in Section IV.

2.3.4 Setting Up a Vendor Purchase Order and Scheduling Exams

This information will assist the academic units in establishing a blanket purchase order with the selected vendor. The phone number for scheduling the exam and the recommended exam location is:

The Eye & Laser Center
900 North San Francisco
Flagstaff, AZ 86001
(928) 779-7000

The clinic will need the department/academic unit name and or specific account information for billing purposes. Personnel should send or bring a copy of the exam or other proof to EH&S for ARRA record keeping purposes.

SECTION III - Laser and Laser System Classification

3.1 Laser Classification

Lasers and laser systems are classified by their ability to cause biological damage to the eye or skin during use. Purchased lasers are labeled and classed by manufacturers to comply with requirements of the Federal Laser Product Performance Standard. Lasers which are modified in ways which may change the classification provided by the manufacturer must be reclassified by the LSO in accordance with ANSI Standard Z-136.1-1993, "American National Standard for the Safe Use of Lasers."

3.1.1 Class I Lasers

Lasers or laser systems incapable of producing damaging radiation during intended use are Class I lasers. These lasers are exempt from any controls or administrative requirements during normal use. Most Class I laser systems contain embedded lasers of a higher class, however. Alignment and service procedures for embedded Class II, III, or IV lasers require appropriate control and administrative procedures appropriate to the class during these functions.

3.1.2 Class II Lasers

Class II lasers (low power) are lasers emitting radiation in the visible portion of the spectrum. Even though the power of these lasers is such that they will normally be protected by a physiological aversion response (blink reflex), personnel should wear laser eyewear for protection since the class II maximum permissible exposure limits can be exceeded if the beam is viewed directly for extended periods.

3.1.3 Class III Lasers

Class III lasers and laser systems (medium power) produce radiation that can cause eye damage when viewed directly, or when a specular reflection is viewed. A diffuse reflection is usually not a hazard.

3.1.4 Class IV Lasers

Class IV lasers and laser systems (high power) produce radiation that may be dangerous to the eye even when viewing a diffuse reflection. The direct beam can produce skin and eye damage and can also be a fire hazard.

3.2 Embedded Lasers

Many laser systems contain embedded lasers which are more hazardous (of higher class) than the system. Alignment or service procedures for embedded lasers must be conducted in accordance with requirements appropriate for the class of the embedded laser.

3.3 Classification by the Laser Safety Officer (LSO)

Lasers or laser systems that are modified in ways that may alter the hazard of the emitted radiation must be reclassified by the LSO in accordance with ANSI Z-136.1-1993. The reclassification will usually be from a lower to a higher class; although modifications of laser systems which provide additional safety features may result in a lower classification.

3.4 Multi-wavelength Lasers

Laser classification will be based on the most hazardous possible configuration for a multi-wavelength laser or laser system.

SECTION IV - Registration for Lasers and Application for Permits

4.1 Registration of Lasers

All Class IIIb and IV lasers at NAU must be registered with EH&S. In general, registrants must be full time faculty or staff of NAU. The NAU commodity code for purchasing regulated lasers is 781092. Also lasers obtained from other sources (such as salvage, government loans, or other universities) must be registered.

4.1.1 Responsibility of Registrant

Responsibilities of registrants include:

- Registering all laser personnel and incidental personnel with EH&S
- Ensuring that operators are properly trained
- Ensuring follow up, termination, and follow up eye examinations in the event of suspected or actual injury
- Ensuring that NAU and ARRA approved control measures are used for Class IIIb and IV lasers
- Notifying the LSO prior to modifications to lasers, changes in procedures, and/or changes in control measures

4.2 Training Required for Operators

All personnel with access to laser control areas must obtain the EH&S laser safety class. Also, operators must be trained in the following topics of the EH&S laser safety class before use of Class III or Class IV laser equipment:

- Fundamentals of laser operations
- Bio effects of laser radiation on the eye and skin
- Relations of specular and diffuse reflections
- Non radiation hazards of lasers (electrical, chemical, reaction byproducts, etc.)

- Laser and laser system classification
- Control measures
- Overall management and employee responsibility
- Medical surveillance

The LSO or a designated representative must provide the EH&S laser safety class for general safety training purposes. Also operators must obtain on-site training with the laser system from the registrant or registrant representative. Training may be arranged by request through the Laser Safety Office.

SECTION V- Laser Hazard Control Requirements

5.1 Overview of Hazard Controls

In general, the following control measures are required for Class IIIb and IV lasers:

- Access restrictions including key master switch, interlocked entry or beam enclosure
- Training of operators and personnel working on or near lasers (on site or general)
- Posting and labeling of rooms and equipment, to include a warning light in the hallway or access entrance
- Protective eyewear and clothing suitable for use with the specific laser system
- Engineering controls such as beam stops, curtains, and enclosures

The exact combination of these control measures depends on the power and type of laser, laser environment, and procedures conducted with laser equipment. The LSO approves control measures prior to operation of lasers.

5.2 Access Restrictions

5.2.1 Master Switch

Class IIIb and IV lasers must have a master switch that is controlled by a key or coded access. Access by key or code must only be provided to trained operators and other personnel approved by the LSO. Exceptions to this requirement may be approved by the LSO provided other engineering and administrative controls are used to prevent unauthorized use of laser equipment.

5.2.2 Interlocked Entry

Entry to rooms containing Class IV lasers and laser systems must be interlocked with the laser to prevent unexpected entry of personnel while the laser is in operation. These interlocks must be engineered so that:

- Rapid egress is allowed at all times and admittance to the laser area is allowed under emergency conditions
- For emergency conditions, a control disconnect switch, panic button, or equivalent device must be available for deactivating the laser
- During continuous operation of a laser, the individual in charge of the interlocked room may momentarily override the safety interlocks to allow access to other authorized personnel if it is clearly evident that there is no optical radiation hazard at the point of entry and if the necessary protective devices are being worn by the entering personnel

Exceptions to these requirements may be approved by the RSC provided alternate engineering and administrative controls are used to prevent unexpected entry of personnel into a hazardous area during laser operations.

5.2.3 Exceptions for Lasers Utilizing Beam Enclosure

In applications of laser or laser systems where the entire beam path is enclosed, certain access restrictions are not needed. See section 5.8 and 5.9.

5.3 Training of Operators and Personnel Working On or Near Lasers

5.3.1 Training

Training shall be provided to each employee working with or around lasers of Class IIIb or IV.

Laser training must be provided by the LSO or a designated representative. Training must cover the following topics:

- Fundamentals of laser operation (physical principles, construction, etc.)
- Bio effects of laser radiation on the eye and skin
- Relations of specular and diffuse reflections
- Non radiation hazards of lasers (electrical, chemical, reaction by products, etc.)
- Laser and laser system classifications
- Control measures
- Overall management and employee responsibilities
- Medical Surveillance

5.4 Posting and Labeling of Rooms and Equipment

5.4.1 Equipment Labels

All classes of lasers or laser systems (except Class I) are required to contain warning labels by the Federal Laser Product Performance Standard. Manufacturers place these labels on laser equipment. These labels must not be removed. Equipment modified or constructed at NAU shall be provided with labels that are clearly visible during operation and affixed to the laser housing or control panel. Labels must be placed on both laser housing and control panel when these are separated by more than 2 meters. Label design and verbiage are provided by the LSO.

5.4.2 Posting of Rooms

Areas containing Class IIIb or IV lasers must be posted with appropriate signs. The design and verbiage of the sign must be approved by the LSO.

5.5 Protective Eye wear and Clothing

5.5.1 Eye Protection Devices

Eye protection devices specially designed for protection against radiation from lasers must be used by all personnel working with or near lasers during laser operation unless engineering, procedural, or administrative controls are used to eliminate likely exposure.

All protective eye wear must be clearly labeled with the optical density and wavelength for which it provides protection.

In addition, eye wear must be marked with a unique identifying label that will assist in maintaining inspection and inventory records required by ARRA regulations.

Eye wear will be inspected by EH&S staff on a semi-annual basis during periodic inspections. Protective eye wear will be removed from service if damaged or otherwise unable to provide protection adequate for laser equipment in use.

5.5.2 Protective Clothing

Where personnel may be exposed to levels of radiation that may damage the skin, protective clothing is required. The LSO determines the need for protective clothing and the type of clothing to be used.

5.6 Engineering Controls

5.6.1 Beam Enclosures

Beam enclosures should be used whenever practical. Use of enclosures will significantly reduce the need for other engineering or administrative controls (see Sections 5.8 and 5.9).

5.6.2 Activation Warning Systems

Inside the laser control area, an alarm (for example, an audible sound such as a bell or chime), a warning light (visible through protective eye wear), or a verbal "countdown" command must be used with Class IIIb and Class IV lasers or laser systems during activation or startup.

Distinctive and clearly identifiable sounds which arise from auxiliary equipment (such as a vacuum pump or fan) and which are uniquely associated with the emission of laser radiation are acceptable as an audible warning.

A warning light outside the control area must be used with Class IIIb and IV lasers. (EH&S should be consulted to determine suitable light sources.)

5.6.3 Emission Delay

For operation of Class IIIb or IV lasers or laser systems, the warning system must be activated a sufficient time prior to emission of laser radiation to allow appropriate action to be taken to avoid exposure to the laser.

5.6.4 Window and Door Barriers

All windows, doorways, open portals, etc., must be either controlled or restricted in such a manner as to prevent escape of potentially hazardous radiation. Typically curtains at door ways are required for Class IIIb and IV lasers in open beam configurations to prevent escape of potentially hazardous radiation. (EH&S should be consulted to determine suitable barrier and curtain materials.)

5.7 Administrative Controls

5.7.1 Standard Operating Procedures

Written procedures should be established for operation, alignment, and maintenance of lasers at NAU. The LSO may require these procedures as part of the approved control measures.

5.7.2 Alignment Procedures

Alignment of laser optical systems (mirrors, lenses, beam deflectors, etc.) must be performed in such a manner that the primary beam, or a specular or diffuse reflection of a beam, does not expose the eye to dangerous levels of radiation.

Written procedures outlining alignment methods may be required. The use of low power (Class I or Class II) visible lasers for path simulation of higher power lasers is recommended for alignment of higher power Class IIIb and Class IV visible or invisible lasers and laser systems.

Experience has shown that a significant ocular hazard may exist during alignment procedures. EH&S can assist in developing safe alignment procedures.

5.7.3 Visitors and Spectators

Spectators shall not be permitted within a laser area during operation of a Class IIIb or Class IV laser or laser system unless:

- Specific protective measures for visitors and spectators have been approved by the LSO
- The degree of hazard and avoidance procedure has been explained to spectators
- Appropriate protective measures are taken

EH&S can help registrants ensure visitors obtain the adequate protection.

5.7.4 Servicing of Lasers

Personnel who require access to Class IIIb or Class IV lasers or laser systems contained within protective housing or protected area enclosure for the purpose of service must comply with the appropriate control measures of the enclosed or embedded laser or laser system. The service personnel shall have the education and training commensurate with the class of the laser or laser system contained within the protective housing.

5.7.5 Modifications of Lasers or Laser Systems

The registrant **must notify the LSO** of any modifications that could change a laser's class and affects its output power or operator characteristics so as to make it potentially more hazardous. The LSO must review the control measures to determine if additional requirements are needed.

5.8 Exceptions for Lasers with Fully Enclosed and Interlocked Beam Paths

In applications of lasers or laser systems where the entire beam path is enclosed, the requirements for Class I laser systems are met and none of the other control measures of this Section are required, provided:

- Interlocks are designed to prevent access to laser radiation. The interlock may be electrically or mechanically interfaced to a shutter, or to power supply in such a way that the beam is interrupted when the protective beam enclosure is opened or removed. These interlocks must be of failsafe design
- The protective housing interlocks must not be defeated during operation
- Adjustments or procedures during service must not cause the interlocks to be inoperative when equipment is returned to normal operating conditions
- When requirements 5.1.1. through 5.1.3. are temporarily relaxed, such as during service, LSO approved control measures must be applied. These may include temporary area control, and administrative and procedural controls

5.9 Exceptions for Lasers with Fully Enclosed Beam Paths Without Interlocks

In application of lasers or laser systems where the entire beam path is enclosed, but the enclosure does not meet the requirements specified in 5.8., the laser is exempt from controls described in Sections 5.2.2, 5.5.1., 5.5.2., and 5.6.4. provided:

- Beam enclosures prevent access to laser radiation.
- Beam enclosures are not removed during normal operation
- When the conditions above are relaxed such as during service, LSO approved control measures are applied

SECTION VI - Emergency Procedures

6.1 Emergency Procedures

Environmental Health and Safety must be notified immediately in the event of any incident involving known or suspected exposure to laser radiation. Laser related injuries have mandatory reporting requirements, which will be performed by the Laser Safety Officer or other NAU EH&S representative. Reporting requirements are outlined in AZRRA Rule R12-1-1436 (see appendix D).

During office hours call EH&S at extension 523-6435. During non-office hours, call NAU DPS dispatch at extension 523-3611 or 523-3000.

Appendix A - Laser Hazards

The intensity of laser radiation is often such that exposure can result in serious and permanent injury to skin and eyes. There are also a number of non-beam hazards associated with laser systems. These include electrical shock, exposure to dyes and chemicals, and production of potentially hazardous beam plumes.

Eye Injury

The site of injury following laser exposure depends on the wavelength. Ultraviolet with wavelengths from 0.2 to 0.215 mm and infrared with wavelengths of 1.4 mm or greater are absorbed in the cornea. Wavelengths from 0.78 to 3 mm are also partially absorbed in the lens. Visible light 0.4 to 0.78 mm is transmitted to the retina. Some light with wavelengths from 0.78 to 1.4 mm will also be transmitted to the retina.

Acute exposure of the cornea can cause corneal burns, or photokeratitis (welder's flash). Lens opacities (cataracts) are associated with chronic exposure of the lens. Chronic exposure of the retina may also result in retinal injury.

All injury described above may be permanent and serious. Exposure of the retina can be particularly hazardous, however, as a result of the focusing effect of the lens. A laser beam originally several mm in diameter may be focused to a spot on the retina of 10 to 20 um diameter. The irradiance of the original beam may be intensified in this manner by a factor of 10,000 or more.

Objects in the center of the field of vision are focused on an area of the retina called the fovea. This area of the retina is the most sensitive and is responsible for most of our visual acuity. Injury of the fovea may result in permanent blindness in the injured eye. If the peripheral areas of the fovea are injured, the effect on vision is less serious. In some cases the effects are not noticeable or distracting.

Skin Injury

Skin burns are caused by radiation from high-powered lasers in the infrared wavelength. Exposure to the skin in all wavelengths may result in erythema, skin cancer, skin aging, dry skin effects, and photosensitive reactions in the skin.

Appendix B - Controlling "Non-Beam" Hazards

Many chemical and physical hazards other than laser radiation can be associated with laser operations that must also be adequately controlled. Consult your Chemical Hygiene plan and contact your designated laboratory safety supervisor for a list of hazards in your area. Inform your supervisor of other hazards identified in the laser control area as well. These hazards are quite often more prevalent and serious than those associated with exposure to the optical radiation. In some cases, such as electrocution, these hazards can be life threatening. These "non-beam" hazards are outlined in this appendix.

A. Electrical Equipment and Systems

1. Always be aware of the high risk of injury and fire in laser operations because of the presence of electrical power sources.
2. The installation, operation, and maintenance of electrical equipment and systems must conform to the standards stated in the National Electric Code. Contact Physical Plant for assistance.

B. Lighting

1. Adequate lighting is necessary in controlled areas.
2. If lights are extinguished during laser operation, provide control switches in convenient locations or install a radio controlled switch.
3. Luminescent strips should be used to identify table and equipment corners, switch locations, aisles, etc.
4. When natural light is not sufficient for safe egress from a laser area during an electrical power failure, install emergency lighting.

C. Ionizing and Non-ionizing Radiation

1. A laser operation may involve ionizing radiation that originates from the presence of radioactive materials or the use of electrical power in excess of 15 kV .
2. Microwave and radio frequency (RF) fields may be generated by laser systems or support equipment.
3. Contact Environmental Health and Safety (EH&S) at 523-6435 to obtain an evaluation of these hazards before starting an operation.

D. Hazardous Materials

1. Bring into the laser area only those hazardous materials that are needed for the operation.
2. All hazardous materials must be properly used, stored and controlled. Consult Materials Safety Data Sheets, the Chemical Hygiene Plan and Risk Management for information.
3. Do not allow laser beams or strong reflections to impinge on combustible materials, explosives, highly flammable liquids or gases or substances that decompose into highly toxic products under elevated temperatures, without providing adequate controls.
4. Conduct or sponsor tests that establish the effects of beam interactions with hazardous materials. Test results can be used to determine safe parameters for laser operation.

E. Dyes and Solutions

1. Dye lasers normally use a lasing medium composed of a complex fluorescent organic dye dissolved in an organic solvent. These dyes vary greatly in toxicity, mutagenicity, and potential carcinogenicity.
2. All dyes must be treated as hazardous chemicals. Most solvents suitable for dye solutions are flammable and toxic by inhalation and/or skin absorption.
3. Obtain Material Safety Data Sheets for all dyes and solvents.
4. Use and store all dyes and solvents in accordance with the University's Chemical Hygiene Plan.
5. Prepare/handle dye-solutions inside a chemical fume hood.

6. Wear a lab coat, eye protection and gloves. Call Risk Management for assistance in glove selection.
7. Pressure-test all dye laser components before using dye solutions. Pay particular attention to tubing connections.
8. Install spill pans under pumps and reservoirs.
9. Be alert to contaminated parts.
10. Keep dye mixing areas clean.

Appendix C- Exposure Limits and Laser Classification

- The principle mechanism for laser injury is thermal. As a result, there is a threshold for the amount of thermal energy transferred to exposed tissue below which there will be no injury. In order to prevent laser injury, a system of exposure limits has been established. Limits were promulgated as a consensus standard by the American National Standards Institute (ANSI Z136.1-1993, "American National Standard for Safe Use of Lasers"). These limits were incorporated into regulations by the State of Arizona (Arizona Administrative code Title 12 Section 1 Article 14, "Rules for the Control of Non-Ionizing Radiation"). Separate exposure limits exist for direct viewing of the laser beam, viewing of a diffuse reflection, and for skin exposure.
- A system of hazard classification has also been developed and is part of the ANSI Standard and State Regulations. It is usually more convenient to establish safety controls based on the laser class than use of the exposure limits. All lasers fall into one of 6 hazard classes.
- **Class I** (Depends on wavelength)
- Any laser or laser system that cannot emit laser radiation in excess of the maximum permissible exposure levels (MPE) discussed above is a Class I laser. There is no hazard.
- HOWEVER, it is important to note that Class I laser systems often imbed more hazardous lasers in the device. Removal of a protective housing may result in access to radiation in excess of MPE's and implementation of the Laser Safety Program for ARRA regulated lasers (IIIb and IV).
- **Class II** (less than or equal to 1 mW average power and if applicable a pulse duration of less than 0.25 seconds)
- These are low power lasers emitting in the visible wavelengths (0.4 to 0.7 mm). **These lasers could result in exposure exceeding MPE's if intentionally viewed for more than 0.25 seconds.** Although, typically this does not happen because of the normal "aversion response" people are not allowed to stare at any laser beam. When people view laser light, the natural response is to blink and move the head and eye away from the bright uncomfortable laser beam. An example of a Class II laser is a HeNe pointer laser of 1 mW or less.
- **Class IIa**
- These laser are lasers emitting light in the visible wavelengths (0.4 to 0.7 mm) which are not intended for prolonged viewing and will not produce a hazard if viewed directly for periods not exceeding 1000 seconds. The exposure will not exceed MPE's if viewed for less than this amount of time.
- **Class IIIa** (1 to 5 mW)
- There are medium power lasers that represent a potential hazard to the eye. Examples would be visible lasers from 1 to 5 mW.
- **Note:** Class IIIa includes lasers with an accessible output between 1 and 5 times the Class I AEL for wavelengths shorter than 0.4 μm or longer than 0.7μm or less than 5 times the AEL for wavelength between 0.4 and 0.7 μm.
- **Class IIIb** (access of IIIa power levels but typically less than 0.5 W average power)
- The hazard for IIIb lasers is potentially greater than that for IIIa. The hazard is still limited to direct viewing of the laser beam, however. These are lasers with output less than 0.5 Watt. These lasers do not produce hazardous diffuse reflections or represent a skin exposure hazard.
- **Class IV** (0.5 W power or higher)
- These are high powered lasers that represent hazards (eye damage, skin injury, and or potential flammable material ignition source) for direct viewing, viewing of diffuse reflections, and skin exposure.
- The power levels for Class IV lasers are at 0.5 W and higher.

Appendix D- AZRRA Rule R12-1-1436

R12-1-1436. Reporting Laser Incidents

- A. A registrant shall notify the Agency by telephone within 24 hours of any incident that has caused or may have caused:
 - 1. Permanent loss of sight in either eye; or
 - 2. Third-degree burns of the skin involving more than 5 percent of the body surface as estimated by the rule of nines.
- B. A registrant shall notify the Agency by telephone within five working days of any incident that has or may have caused:
 - 1. Any second-degree burn of the skin larger than one inch (2.54 centimeter) in greatest diameter; or
 - 2. Any third-degree burn of the skin; or
 - 3. An eye injury with any potential loss of sight.
- C. Each registrant shall file a written report with the Agency of any known exposure of an individual to laser radiation or collateral radiation within 30 days of its discovery, describing:
 - 1. Each exposure of the individual to laser or collateral radiation that exceeds the applicable MPE; and
 - 2. Any incident that triggered a notice requirement in subsections (A) or (B).
- D. Each report required by subsection (C) shall describe the extent of exposure to each individual including:
 - 1. An estimate of the individual's exposure;
 - 2. The level of laser or collateral radiation involved;
 - 3. The cause of the exposure; and
 - 4. The corrective steps taken or planned to prevent a recurrence.
- E. A registrant shall not operate or permit the operation of any laser product or system that does not meet the applicable requirements in this Article.

Editor's Note: The tables referenced in subsection (A) were repealed effective January 2, 1996.