15. Radiation Safety

The following sections provide general safety guidelines and procedures for radiation safety. This section covers the following topics:

List of Figures

15.1 Radiological Safety at Texas State University

The State of Texas regulates the use of radiation through the Texas Department of State Health Services. Use of Radiation devices, sources, and lasers at Texas State University must be in compliance with the Texas DSHS Radiation Control Program Regulations.

The Radiation Safety Program outlines the requirements for the safe utilization of both radioactive materials and radiation emitting devices on the university campus. Further details are provided in the Radiation Safety Manual.

Texas State University maintains strict requirements for working with sources of radiation. The radiation safety program purpose is to protect employees, students, and visitors as well as the public and the environment from the harmful effects of exposure to ionizing and non-ionizing radiations. The Environmental Health, Safety & Risk Management Office (EHSRM) governs the protocol and use of radioactive materials and radiation-producing devices on campus.

Any faculty or staff member who desires to work with radioisotopes or radiation-producing devices must apply for and receive a permit from the EHSRM. In addition, their employees and other employees who work with sources of radiation must receive formal training in equipment operation, safety guidelines, and emergency procedures.

Figure 1 - Radiation Symbol

15.2 Radioactive Materials

With regard to the use of licensed radioactive materials, these policies apply to sealed sources as well as to open isotopes regardless of physical or chemical form.

- Radioactive materials may only be possessed by or under the supervision of individuals who have been formally permitted.
- Permit Holders or their designees shall obtain approval from the Radiation Safety Officer (RSO) before placing an order for radioactive materials. Approvals are also required before Permit Holders receive radioactive materials via transfer from another licensee, via donations, etc.
- All sources of radiation shall be secured from unauthorized access or removal.
- All radioactive wastes shall be disposed through the RSO or via written procedures approved by the RSO.
- All persons are responsible for safe working practices and for maintaining their own exposures to ionizing radiations As Low As Reasonably Achievable (ALARA).
- Each user is responsible for reporting unsafe practices and/or rules violations to the Permit Holder or, if responses are not satisfactory, to the RSO or the Texas Department of State Health Services.

> **Note**:
> Ionization type smoke detectors normally contain approximately 1 microcurie of Amercium-241, an alpha emitting isotope with a 432 year half-life. Contact the EHSRM office regarding disposal instructions when replacing this type of smoke detector.

15.3 Lasers

The State of Texas regulates the use of lasers through the Texas Department of State Health Services. The Texas State University EHSRM registers, and is responsible for, the safe use of all lasers on campus.

The Laser Safety Program outlines the requirements for the safe utilization of Class 3b and Class 4 laser devices on the university campus. Further details are provided in the Laser Safety Manual.

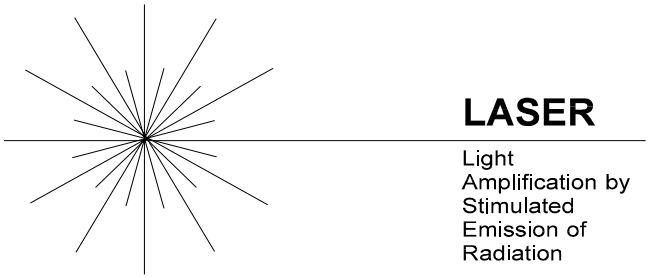

Figure 2 - LASER Symbol

Lasers present many safety threats, but the most common threat is damage to the eyes. Other common laser concerns include skin damage, electrical hazards from high-energy power sources, chemical exposure, fire/explosion hazards, and exposure to cryogenic materials such as hydrogen and oxygen. Many lasers emit invisible ultraviolet or infrared radiation.

Lasers are classified into five basic categories as indicated below:

- Class 1:

  Lowest power lasers that do not emit hazardous levels
- Class 2:

  Low power visible light lasers that pose a hazard only if viewed directly for extended periods
- Class 3a:

  Intermediate power lasers that would not normally cause injury to the eye unless viewed with collection optics
- Class 3b:

  Medium power lasers that pose moderate risk and can cause injury
- Class 4:

  High energy, high-risk lasers that can cause injury to the eyes and skin from direct or diffused reflection

> **NOTE***:*
> If you work with a class 3b or 4 laser, you must obtain a Laser Permit from the Environmental Health, Safety & Risk Management Office (EHSRM).

Laser devices require engineering controls to ensure safety. All Class 3b and 4 lasers require a combination of protective housing, area warning signs or remote firing capabilities.

The following information is required for obtaining a laser permit:

- Classification of the laser device
- Wavelength of the laser output
- Power output
- Appropriate eyewear

Follow these guidelines when working with Class 3b and 4 lasers:

- Never aim a laser at a person.
- Be very careful when working with hand-held laser pointers.
- Do not allow children access to pointers.
- Wear protective clothing such as eyewear and skin protection as appropriate.
- Post warning signs at entrances where lasers are present.
- When working with power supplies, remove jewelry, stand on a dry surface, and work with only one hand at a time. Observe high voltage precautions (see Electrical Safety chapter).
- Control access to areas where lasers are used (i.e., no spectators).
- If possible, enclose the entire laser beam path on Class 4 lasers.

15.4 Radiofrequency Radiation (RF)

"Radiofrequency (or RF) Radiation" refers to electromagnetic fields with frequencies between 300 kHz and 300 MHz, while "Microwave (or MW) Radiation" covers fields from 300 MHz to 300 GHz. Since they have similar characteristics, RF and MW radiation are usually treated together. As well, the lower-frequency boundary of RF radiation is often extended to 10 kHz, or even to 3 kHz, in order to include emissions from commonly used devices.

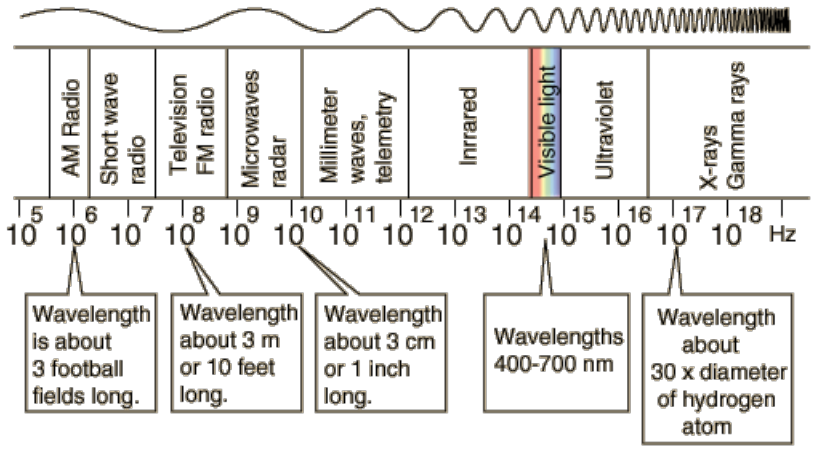

Figure 3 - Electromagnetic Spectrum

- RF radiation is produced by devices such as radio and TV transmitters, induction heaters, and dielectric heaters (also known as RF sealers). MW radiation is produced by microwave ovens, parabolic (dish) antennas, radar devices, and diathermy applicators. See Table I, "Sources of RF/MW Radiation," for more examples.
- Federal legislation requires that microwave ovens be constructed to meet stringent microwave leakage limits and to have safety interlocks. When these interlocks are defeated, for example, during repair work, there is a risk of overexposure to microwave radiation.
- This guide gives advice on preventing overexposure to RF/MW radiation in the workplace. However, this guide cannot cover all possible situations. The requirements set out in the Occupational Health and Safety Act must be complied with, and they should be referred to when this guideline is used.

A. Health Hazards

- The nature and the degree of the health effects of overexposure to RF/MW fields depend on the frequency and intensity of the fields, the duration of exposure, the distance from the source, any shielding that may be used, and other factors.
- The main effect of exposure to RF/MW fields is heating of body tissues as energy from the fields is absorbed by the body. Prolonged exposure to strong RF/MW fields may increase the body temperature, producing symptoms similar to those of physical activity. In extreme cases, or when exposed to other sources of heat at the same time, the body's cooling system may be unable to cope with the heat load, leading to heat exhaustion and heat stroke.
- Localized heating, or "hot spots," may lead to heat damage and burns to internal tissues. Hot spots can be caused by non-uniform fields, by reflection and refraction of RF/MW fields inside the body, or by the interaction of the fields with metallic implants, for example, cardiac pacemakers or aneurism clips. There is a higher risk of heat damage with organs which have poor temperature control, such as the lens of the eye and the testes.

- Other hazards include contact shocks and RF burns. These can result from the electric currents which flow between a conducting object and a person who comes into contact with it while they are exposed to RF fields. (These effects should not be confused with shocks from static electricity.)
- Some laboratory studies have reported biological effects from RF/MW radiation at field levels which are too low to cause tissue heating. To date, these non-thermal effects are not known to result in health hazards. Although we are constantly exposed to weak RF fields from radio and television broadcasting, no health risks have been identified from this low-level exposure.
- Recent reports suggesting a relationship between either cellular telephone or traffic radar use and cancer have not been substantiated.

B. Controlling RF/MW Radiation

- Engineering Controls
  - Sources of RF/MW radiation should be properly shielded to minimize stray radiation.
  - Devices which can produce acute thermal injuries (e.g., industrial MW ovens) should have interlocked doors.
  - Devices which produce high levels of stray RF radiation (e.g., induction heaters and dielectric heaters) should be operated remotely whenever possible.
- Administrative Controls
  - Exposure of workers to RF/MW Radiation should not exceed the recommended exposure limits.
  - Areas where worker exposure to RF/MW Radiation is suspected to exceed the recommended limits should be surveyed to determine the exposure levels.
  - Needless exposure to RF/MW fields should be avoided.
  - Exposure times should be kept as short as reasonably possible.
  - Potentially hazardous RF/MW devices should be appropriately labeled, and areas of excessive exposure around them clearly demarcated. Notices with warnings and the necessary precautions should be posted.
  - Electrically-activated explosive devices should not be placed near sources of RF/MW radiation.
  - RF/MW devices should not be used in flammable or explosive atmospheres.
  - Equipment sensitive to RF/MW radiation, such as telephone switchboards or control panels, should not be installed near sources of RF/MW radiation.
  - Maintenance of devices used to produce RF/MW radiation should be done by qualified personnel following standard safety procedures. The equipment should be turned off whenever possible.

- Personal Protection
  - When exposures cannot be reduced by the above methods, RF/MW protective suits, including head and eye protection, can be used. Suits should be tested to ensure that they reduce worker exposure to levels below the occupational exposure limits and that they do not pose any safety hazards (e.g., overheating, shocks, or fire).
- Controlling RF Shocks and Burns
  - Metallic structures producing contact shocks should be electrically grounded and/or insulated.
  - Insulating platforms or shoes (e.g., rubber-soled shoes) can be used to reduce energy absorption and currents to ground.
  - When the above measures are ineffective or not reasonably possible, workers should wear insulating gloves.
- First Aid
  - Remove worker from exposure area to a cool environment and provide cool drinking water.
  - Apply cold water or ice to burned areas.
  - Seek immediate medical attention.
  - Severe MW or RF overexposure may damage internal tissues without apparent skin injury, so a follow-up physical examination is advisable.

C. Microwave Ovens

- Metal reflects microwave radiation, but dry nonmetallic surfaces allow microwaves to pass through with little or no heating effect. Organic materials, however, are extremely heat conductive. Because microwaves can penetrate organic materials, including tissues, thermal burns and other effects may result from microwave exposure.

NOTE:
Microwave ovens are very safe when kept in good working condition and used properly. They do not serve as a source of exposure to harmful microwaves.

- Even though microwave ovens are not a source of harmful radiation exposure, they should be properly used and maintained.
  - Do not put metal objects (including aluminum foil) into a microwave oven.
  - Do not use a microwave oven if it is damaged.
  - Ensure that the seal on a microwave oven is tight, intact, and in good condition (i.e., not charred or distorted).
  - Ensure that microwave ovens are clearly labeled for laboratory use or food preparation only.
  - Microwave ovens should only be repaired by trained personnel.

15.5 Radiation-Producing Devices

Radiation-producing devices such as X-ray machines and particle accelerators are regulated through the Texas Department of State Health Services. All radiation-producing devices must be registered with the Texas State University EHSRM.

The Radiation Safety Program outlines the requirements for the safe utilization of x-ray producing devices on the university campus. Further details are provided in the Radiation Safety Manual.

Radiation-producing devices (other than human and veterinary diagnostic devices) shall be interlocked to prevent access to the unshielded beam during normal or routine operations. Exceptions may be granted by the Texas State University Radiation Safety Officer.

IMPORTANT!

The door(s) to a room where a radiation-producing device is located should be posted with a radiation warning sign, unless the device is totally self-contained.

15.6 Ultraviolet Lamps

Ultraviolet (UV) lamps are useful germicidal tools, but they also pose a potential health hazard. The following sections provide essential safety information for working with UV lamps and light.

A. Health Hazards

Exposure to UV radiation can cause extreme discomfort and serious injury. Therefore, you must protect your eyes and skin from direct and reflected UV light. Pay particular attention to laboratory surfaces, such as stainless steel, that can reflect UV light and increase your UV exposure.

The effect of UV radiation overexposure depends on UV dosage, wave length, portion of body exposed, and the sensitivity of the individual. Overexposure of the eyes may produce painful inflammation, a gritty sensation, and/or tears within three to twelve hours. Overexposure of the skin will produce reddening (i.e., sunburn) within one to eight hours. Certain medication can cause an individual to be more reactive to UV light.

B. Personal Protective Equipment

Adequate eye and skin protection are essential when working around UV radiation. Before entering a laboratory with ultraviolet installations, you must turn off the lights or wear protective equipment (e.g., goggles, cap, gown, and gloves).

NOTE:

Safety glasses with side shields or goggles with solid side pieces are the only equipment that provide adequate eye protection against direct and reflected UV light.

C. Germicidal Function

UV radiation is particularly useful in the laboratory when combined with other methods for decontamination and disinfection. UV radiation is used primarily to reduce the number of microorganisms in the air and on surfaces. It is most effective against vegetative bacteria.

UV rays can only kill organisms that are invisible to the naked eye. To be effective, UV rays must directly strike the microorganisms. If microorganisms are shielded by a coating of organic material (e.g., culture medium), the UV light will be ineffective.

D. Maintenance

Ultraviolet lamps lose germicidal effectiveness over time and may need to be replaced even though the lamp has not burned out. It may be necessary to replace the lamp according to the manufacturer's recommendations. There are two types of UV lamps – hot cathode and cold cathode. The hot cathode lamp has two pins at each end, and the cold cathode lamp has one pin at each end. Manufacturers recommend that hot cathode lamps should be replaced every six months and that cold cathode lamps should be replaced every 12 months.

In addition to replacing UV lamps as indicated above, follow these guidelines to maintain UV lamps:

- Regularly wipe cool, unlit UV lamp bulbs with a soft cloth moistened with alcohol. (Dust can decrease the effectiveness of a UV lamp.)
- Do not touch a UV bulb with your bare hands. The natural oils on your hand may leave a fingerprint and create dead space on the bulb's surface.

END OF SECTION