10.0 **Laboratory Safety**

The door to each laboratory utilizing hazardous equipment, toxic or flammable chemicals, and to hazardous materials storage rooms must be posted with an emergency response sign listing the nature of the hazards and name(s) and phone number(s) (work and home) of the individuals who are responsible for and/or familiar with the hazards and secured against unauthorized entry when the laboratory is unattended.

10.1 Flammable Liquids In Laboratories And Chemical Storage Rooms

The storage and use of flammable liquids in laboratories shall comply with the applicable provisions of the National Fire Protection Association Standard 45, Fire Protection For Laboratories Using Chemicals, 1997.

Refrigerators used for the storage of flammable liquids must be designed for this purpose and labeled as such. Domestic refrigerators may not be used for flammable liquids storage and must bear a label prohibiting flammable storage. Existing domestic refrigerators modified by MTU Facilities Department may continue to be used for flammable storage as long as they are properly labeled. Explosion-proof refrigerators (also referred to as intrinsically safe) are intended for use in locations where the atmosphere outside the refrigerator is, or is reasonably likely to be, explosive and are typically not required in MTU laboratory environments.

Most laboratory fires are caused by ignition of flammable liquid spills or vapors that have spread from open containers near ignition sources such as hot-plates and burners. Experiments and demonstrations should be planned in advance to ensure that sufficient distance is maintained between ignition sources and exposed flammable liquids (some solvent vapors can spread 10 feet or more along a bench top or floor).

The purpose of a flammable liquid storage cabinet is to delay the ignition of stored flammable liquids during a laboratory fire. It is not intended to contain or remove harmful or foul smelling vapors from poorly capped or contaminated containers. Venting of storage cabinets can reduce the level of fire protection and is discouraged except when the contents are so volatile and foul smelling that it is absolutely necessary. Venting must be accomplished according to the manufacturer's recommendations and in compliance with building fire safety codes and with the approval of Occupational Safety and Health Services and Facilities Management. The vent covers provided with the cabinet must be maintained in place at all times except when removed for the installation of a vent system.

Storage of flammable liquids within a laboratory shall be limited to that required for the operation of the laboratory in addition to the following restrictions for laboratories and chemical storage rooms:

- Containers of Class IA liquids shall not exceed one pint capacity for glass containers, one gallon capacity for metal or approved plastic, or two gallons capacity for safety cans.

- Containers of Class IB liquids shall not exceed one quart capacity for glass containers, five gallons capacity for metal or approved plastic and safety cans.

- Containers of Class IC liquids shall not exceed one gallon capacity for glass containers, five gallons capacity for metal or approved plastic and safety cans.

- Containers of combustible liquids shall not exceed one gallon capacity for glass containers, five gallons capacity for metal or approved plastic containers and safety cans, and 60 gallons for metal drums.

- Not more than five gallons of Class I flammable liquids - or 10 gallons for Class I and combustible liquids combined - shall be stored outside of a UL listed or FM approved storage cabinet per 100 gross square feet of floor space.

- The maximum total amount of flammable liquids stored inside and outside of approved storage cabinets may not exceed ten gallons of Class I flammable liquids - or 20 gallons for Class I and combustible liquids combined - per 100 gross square feet of space.

Definitions:

Approved Plastic - A plastic container approved for shipment of a particular flammable liquid under Chapter I, Title 49 of the Code of Federal Regulations.

Class IA flammable liquid - a liquid having a flash point below 73 F (22.8 C) and having a boiling point below 100 F (37.7 C).

Class IB flammable liquid - a liquid having a flash point below 73 F (22.8 C) and having a boiling point at or above 100 F (37.7 C).

Class IC flammable liquid - a liquid having a flash point at or above 73 F (22.8 C) and below 100 F (37.7 C).

Combustible liquid - a liquid having a flash point at or above 100 F.

10.2 Chemical Laboratories

10.2.1 Chemical Hygiene Plan

Chemical laboratories requiring a chemical hygiene plan and a chemical hygiene officer are those which use multiple chemical procedures or chemicals in a laboratory environment (i.e., where protective laboratory practices and equipment are available and in common use to minimize the potential for employee exposure to hazardous chemicals). Pilot plant operations which simulate production processes are exempt.

Departments with laboratories meeting the MIOSHA definition of a chemical laboratory must appoint a chemical hygiene officer who will assist in the development and implementation of a written department-specific chemical hygiene plan. The chemical hygiene plan will contain procedures for procurement, storage, use, and disposal of laboratory chemicals as well as the use of emergency equipment, personal protective equipment, engineering controls, and administrative controls for student and employee protection against laboratory hazards. The chemical hygiene plan must also contain laboratory-specific standard operating procedures, SOPs, for each chemical procedure. The written laboratory-specific SOPs must include a list of chemicals in use, the required personal protective equipment to be used for each procedure, and the safe work practices for each procedure. Spill response and waste disposal procedures should also be addressed in the SOP.

The department chemical hygiene officer shall be qualified by training or experience to provide technical guidance in the development and implementation of the provisions of the chemical hygiene plan. This should include a knowledge of the regulatory requirements for laboratory work as well as chemical safety and related industrial hygiene practices; supervisory experience; knowledge of department-specific chemical operations, inventories, hazards, purchasing and disposal practices, and safety equipment; and good written and verbal communication skills.

10.2.2 Chemical Labels and Material Safety Data Sheets

The labels on incoming chemical reagent containers must be maintained and a label containing the same chemical hazard information must be applied if the material is transferred into another container. Laboratory preparations must be labeled with the chemical identity of the contents, the date, and the identity of the owner. Chemical formulas are not acceptable as part of the identity description except for those that would be recognized and understood by faculty and staff outside the department. If the laboratory preparation is transferred to another location the label must also include a primary hazard warning statement. A material safety data sheet or its equivalent may be required if the material is to be shipped off campus.

It is the responsibility of the person who receives an incoming chemical shipment to retain any material safety data sheets that are included and to forward a copy to the Chemical Stores facility for placement in the archives. Each department may decide how and where material safety data sheets will be made available to students and employees as long as they are available whenever students or employees are on site. The Chemical Stores archive does not meet the requirement for availability, and therefore, may not be referenced on the required MIOSHA workplace notification poster, available from OSHS.

10.2.3 Fume Hoods

Fume hoods are a critical component of the total safety and health protection system provided to students and employees working with hazardous materials and serve to protect the rest of the building occupants as well. However, a fume hood is only effective if it is designed, installed, maintained, and used properly. Fume hood users share responsibility for ensuring that the hoods are properly maintained by notifying the laboratory supervisor or department chair whenever a fume hood is not functioning properly. The fume hood user is also responsible for properly utilizing the hood. The following guidelines should be considered:

- Always work in a fume hood rather than on an open bench when using substances that have objectionable odors or emit toxic or flammable vapors.

- Verify proper air flow in the hood before starting work by checking the built-in flow meter or by holding a piece of paper towel near one of the air slots at the rear of the hood (learn to distinguish between the strength of the airflow caused by the blower and the flow caused by the "chimney effect" when the blower is not running). The sound of the blower motor is no assurance of hood operation because the drive belt may have failed.

- Remove everything from the hood that is not needed for the work to be performed.

- Avoid situations that could cause cross-drafts in front of the hood like open windows or doors, fans, pedestrian traffic, rapid movement of hands in or out of the hood, or rapid changes in sash position.

- Always work with the sash in the lowest possible position.

- Set up work at least six inches behind the plane of the sash.

- Adjust the hood baffles, if available, for the anticipated density of vapor emissions relative to that of the surrounding air. Emissions lighter than air as a result of heating or low molecular weight should correspond to shifting the baffle opening toward the top of the hood and vapors heavier than air should be captured near the bottom.

- Use a support stand, if possible, to keep large containers and instruments a few inches above the work surface inside the hood to improve air flow around the setup.

- Avoid placement of cabinets or other objects in close proximity to the hood that might restrict the operator's ability to back away during an emergency or that cause turbulence in the airflow into the hood.

- Work with heated perchloric acid only in a properly functioning perchloric acid hood. Be sure you are familiar with the manufacturer's operating instructions.

- California hoods are designed to be operated with all doors fully closed.

- "Walk-in" hoods are not intended to be entered by the operator while in use. They are designed to permit the use of larger setups than a benchtop hood can accommodate. The same general principles of operation apply as for a benchtop hood.

- Pay attention to the most recent face velocity measurement posted on the hood. Do not work with highly toxic substances in a hood with a face velocity significantly less than 100 fpm.

- Use only intrinsically safe electrical instruments and connections in a hood when using heated or highly volatile flammable liquids and eliminate all other sources of ignition.

- The hood sash is not an explosion shield. If an explosion is the possible outcome of an instrument or operator failure, the experiment should be operated remotely or in a specially designed test cell or facility.

10.2.4 Chemical Purchases

Laboratory chemicals may not be delivered directly to an individual's office. All deliveries must be made to an area staffed during University operating hours by personnel who have been trained in accordance with the MTU Hazard Communication Plan and the Department of Transportation requirements. The delivery area and process must also provide for adequate security to prevent unauthorized access to the chemicals.

The MTU Purchasing Department procurement card policy forbids their use for laboratory chemical purchases.

When laboratory chemicals are purchased on blanket purchase orders, it is the responsibility of the person placing the order to forward a copy of the material safety data sheet to Occupational Safety and Health Services for archiving.

10.3 Radiation Producing Equipment and Materials

10.3.1 Nuclear Regulatory Commission Regulated Materials

Work involving equipment or materials regulated by the Nuclear Regulatory Commission, NRC, is overseen by the MTU Radiation Safety Committee and the Radiation Safety Officer, RSO, in the Occupational Safety and Health Services Department. Requirements and procedures for the purchase, use, storage, and disposal of these materials is described in the MTU Radiation Safety Manual. Only employees specifically named in the MTU radioactive materials license may purchase these materials and each purchase must be approved by the RSO in advance. Faculty and staff wishing to engage in research involving radioactive materials should contact the RSO for information and assistance in obtaining any necessary approvals.

10.3.2 Ionizing Radiation Producing Equipment and Radioactive Materials

The installation and use of equipment which generates ionizing radiation is regulated by the Radiation Section of the Michigan Bureau of Health Systems. Radiative materials used as radiation sources in such equipment are also regulated by the Michigan Department of Environmental Quality if they are not regulated by the NRC. The MTU Radiation Safety Committee and RSO also oversee the use of these devices. Faculty and staff intending to purchase equipment that produces ionizing radiation, for example, x-ray diffraction machines, scanning electron microscopes, gas chromatographs, etc., must first contact the RSO for information about registration, operation, and training.

10.3.3 Lasers

Each department utilizing laser equipment is responsible for ensuring that the equipment is classified and labeled according to the requirements of the Federal Laser Product Performance Standard: Title 21 of the Code of Federal Regulations; Part 1000; [parts: 1040.10 and 1040.11]. Depending on the power output classification of the laser(s) in use, the department may need to designate a laser safety officer, LSO, to oversee the installation, use, and maintenance of equipment as well as the training of personnel. The University written Laser Safety Guide contains important information from the Occupational Safety and Health Administration on laser safety.

10.4 Biological Laboratories

All activities involving the use of recombinant DNA/RNA must receive prior approval of the Institutional Biosafety Committee. Work involving infectious agents generally requiring Biosafety Level 2 or 3 practices must receive prior approval of the Biological Safety Committee. Activities requiring Biosafety Level 4 practices are forbidden at this time.

Activities involving the use of human body fluids, cell lines, and unfixed tissues require training and implementation of a written bloodborne infectious diseases exposure control plan.

Activities involving the use of nonhuman primate body fluids, cell lines, and unfixed tissues require training and documentation.

Activities that generate Medical Waste (sharps and potential or known human pathogens including zoonotic) require training and site registration with the Michigan Department of Health. Decontaminated biohazardous waste may not be placed in the regular trash without removal of all biohazard labels and markings. Overpacking or covering a biohazard label are not acceptable.

Activities involving the release of plants or organisms into the environment require completion of a USDA permit application.

10.5 Shipping Hazardous Materials

Shipments of hazardous materials such as explosives, compressed gases, flammable solids and liquids, oxidizers, toxic and infectious materials, radioactive materials, corrosive substances, and environmental pollutants are regulated by the Department of Transportation, DOT, regardless of quantity. Employees who offer such materials for shipment as well as those responsible for receiving shipments must be trained in accordance with DOT regulations. Contact Occupational Safety and Health Services for information and assistance with training and shipments of materials that could potentially be regulated.