Northwestern University Department of Chemistry Laboratory Dress Code

Updated: 3/3/2020

The Department of Chemistry's dress code for any person working in a laboratory amplifies the direction as defined by Research Safety in Chapter 5.3 of its *Laboratory Safety and Chemical Hygiene Plan* (enclosure A).

Clothing: All lab workers are expected to wear appropriate clothing while in any area defined as a laboratory area. This includes offices attached to the lab. Shirts must cover the entire torso and upper arms. A lab coat must be worn over tank tops, sleeveless shirts, or short-sleeve shirts. Pants/dresses/skirts must cover from waist to ankle. No shorts, short/mid-length skirts, or short pants are allowed.

Shoes: Lab workers are required to wear substantial closed-toed shoes that cover the entire foot while in the laboratory space to protect against chemical splashes or broken glass. Do not wear sandals, cloth sport shoes, perforated shoes, or open-toed shoes. If you clean up a spill from the floor, you may need the added protection of rubber boots or plastic shoe covers. Safety shoes may be required for handling heavy items, such as gas cylinders or heavy equipment components.

Personal Protective Equipment (PPE): All students, faculty, and staff are required to wear proper personal protective equipment while in a lab. The vast majority of all necessary PPE is free from Research Safety.

Eye Protection: *OSHA Regulation 29 CFR Part 1910.133* requires protective eye and face equipment when a lab worker is "exposed to eye or face hazards from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, or potentially injurious light radiation." Eye protection is required in all laboratories where chemicals are used or stored. Safety glasses with clear side shields are adequate protection for general laboratory use. Goggles shall be worn when there is danger of splashing chemicals or flying particles, such as when chemicals are poured or glassware is used under elevated or reduced pressure. A face shield with goggles offers maximum protection (for example, with vacuum systems that may implode). Corrective lenses in spectacles do not in themselves provide sufficient protection. Wear goggles over your eyeglasses, or order prescription safety glasses through Eyelation. Individuals with access to Class 3b and Class 4 levels of laser radiation shall wear eye protection that conforms to *Illinois Administrative Code Title 32 Part 315.100.b.5* (enclosure C).

Lab Coat: A fully buttoned (snapped) lab coat is required while in a wet chemistry area and handling chemicals or working inside a fume hood. The lab coat must be a Flame Resistant (FR) rated coat. Remember that the lab coat is only effective if clean and fully buttoned (or snapped).

Gloves: Northwestern issued (approved) gloves – matched to the hazard – must be worn while working with hazardous chemicals, glassware, equipment or processes. Reference Chapter 5.3.3 of the *Laboratory Safety and Chemical Hygiene Plan* (enclosure A) to select the appropriate gloves. Chemicals can eventually permeate all glove materials. Select glove materials resistant to the chemical being used, and change gloves periodically to minimize penetration. The chemical resistance of common glove materials varies according to the glove manufacturer, as manufacturers may vary the thicknesses and formulations of materials. Research Safety can help with any glove selection questions.

Compliance: Non-Compliance with this laboratory dress code is contrary to safe conduct of science and subject to departmental and institutional oversight, including the possible closure of the laboratory.

Laboratory Safety and Chemical Hygiene Plan (Chapter 5)

5.3 Personal Protective Clothing and Equipment

You have a responsibility to dress sensibly for laboratory work. Some protection is afforded by ordinary clothing and eyeglasses.

Personal protective clothing and equipment protects you from injury due to absorbing, inhaling, or coming into physical contact with hazardous materials. You are responsible for using special protective clothing and equipment when they are required for safety. Protective wear may include laboratory coats, wraparound gowns, cloth masks, coveralls, aprons, gloves, shoe covers, and respirators. Select garments and fabric based on the nature of the hazardous agent.

Research Safety provides a basic set of PPE – lab coat, gloves and eye protection – to all registered laboratory workers. The standard lab coat fabric is 100% cotton and additionally treated for Flame-resistant (FR). FR-rated clothing has a distinctive label affixed to it.

Research Safety facilitates lab coat laundry service. Simply bring a dirty lab coat to the Evanston Research Safety Office or the Chicago Fisher Stockroom. You can pick out a clean lab coat of the same size. For those who wish to have their own personal lab coat returned to them, you will need to have it cleaned through University Services and your department assumes the cost.

Do not wash lab coats or contaminated clothing with other personal laundry.

5.3.1 Clothing

Cover unprotected skin whenever possible. Suitable clothing shall be worn in the laboratory space; shorts are not appropriate. Clothing may absorb liquid spills that would otherwise come in contact with your skin. Long sleeves protect arms and shall fit snugly, especially when you are working around machinery. Nomex and wool affords more protection from flash burns or corrosive chemicals than cotton or synthetic fabrics. Some synthetic fabrics may increase the severity of injury in case of fire. Cotton is less prone to static electricity buildup than nylon or other synthetics.

Wear substantial closed-toed shoes in the laboratory space to protect against chemical splashes or broken glass. Do not wear sandals, cloth sport shoes, perforated shoes, or open-toed shoes. If you clean up a spill from the floor, you may need the added protection of rubber boots or plastic shoe covers. Steel-toed shoes may be required for handling heavy items, such as gas cylinders or heavy equipment components.

Aprons, laboratory coats, gloves, and other protective clothing, preferably made of chemically inert material, shall be readily available and used. Laboratory coats are essential to protect street clothing from biological agent aerosols or chemical and radioactive material splashes and spills, vapors, or dusts. For work involving carcinogens, disposable coats may be preferred. For work with mineral acids, acid-resistant protective wear is desirable.

When the potential for fire exists, consider wearing a laboratory coat specifically designed to be flame retardant. Several types of flame-resistant clothes are available from safety suppliers. A low-cost option is a disposable cotton coat that has been treated with a flame-resistant material. The treatment slows

combustion and provides an additional level of protection from fire and heat. However, repeated washing degrades the chemical treatment and compromises fire protection.

More durable flame-resistant cotton laboratory coats are also available. A fabric known as Nomex provides the best protection against flame hazards. This material has a structure that thickens and carbonizes when exposed to heat. This unique characteristic gives Nomex lab coats excellent thermal protection. Because the characteristics of the material are inherent to the fiber, repeated laundering does not change the thermal protection capabilities.

***See Table 5.3.1 Properties of Protective Clothing Material (enclosure B) for additional information.**

5.3.2 Eye Protection

Eye protection is mandatory in laboratory spaces because of the obvious hazards of flying objects, splashing chemicals, and corrosive vapors. Eyes are very vascular and can quickly absorb many chemicals. Regulations require protective eye and face equipment where there is a reasonable probability that using them can prevent injury. Eye protection shall be required in all laboratories where chemicals are used or stored. Eye protection is not interchangeable among employees and shall be provided for each individual unless disinfected after use.

Safety glasses with clear side shields are adequate protection for general laboratory use. Goggles must be worn when there is danger of splashing chemicals or flying particles, such as when chemicals are poured or glassware is used under elevated or reduced pressure. A face shield with goggles offers maximum protection (for example, with vacuum systems that may implode).

Corrective lenses in spectacles do not in themselves provide sufficient protection. Wear goggles over your eyeglasses, or order prescription safety glasses through Eyelation. Eyelation kiosks for Northwestern University faculty, staff and students are available in the Research Safety offices.

5.3.3 Gloves

Gloves are worn to prevent skin contact with toxic, radioactive or biological agents, burns from hot or extremely cold surfaces or corrosives, or cuts from sharp objects. Many gloves are made for specific uses. For adequate protection, select the correct glove for the hazard in question.

Leather and Kevlar gloves provide good protection for picking up broken glass, handling objects with sharp edges, and inserting glass tubing into stoppers. Cuts from forcing glass tubing into stoppers or plastic tubing are a common laboratory accident and are often serious. However, because they absorb liquid, these gloves do not provide protection from chemicals, nor are they adequate for handling extremely hot or cold surfaces. Gloves designed to insulate against hot surfaces and dry ice are not suitable for handling other chemicals.

Sometimes the ideal glove is actually two gloves worn together. Wearing one pair of gloves (such as reusable nitrile, neoprene, butyl, or Viton) over a flexible laminate combines the advantages of both.

When choosing an appropriate glove, consider the required thickness and length of the gloves as well as the material. Consult the glove manufacturer for chemical-specific glove recommendations and information about degradation and permeation times. Certain disposable gloves should not be reused.

- Butyl is a synthetic rubber with good resistance to weathering and a wide variety of chemicals.
- Natural rubber latex is a highly flexible and conforming material made from a liquid tapped from rubber plants. Use of latex is not recommended as it can cause allergic reactions.
- Neoprene is a synthetic rubber having chemical and wear-resistance properties superior to those of natural rubber.
- Nitrile is a copolymer available in a wide range of acrylonitrile content; chemical resistance and stiffness increase with higher acrylonitrile content.
- Polyethylene is a fairly chemical-resistant material used as a freestanding film or a fabric coating.
- Poly (vinyl alcohol) is a water-soluble polymer that exhibits exceptional resistance to many organic solvents that rapidly permeate most rubbers.
- Poly (vinyl chloride) is a stiff polymer that is made softer and more suitable for protective clothing applications by the addition of plasticizers.
- Polyurethane is an abrasion-resistant rubber that is either coated into fabrics or formed into gloves or boots.
- 4H® or Silvershield® is a registered trademark of North Hand Protection; it is highly chemical-resistant to many different classes of chemicals.
- Viton®, a registered trademark of DuPont, is a highly chemical-resistant but expensive synthetic elastomer.

Chemicals can eventually permeate all glove materials. Select glove materials resistant to the chemical being used, and change gloves periodically to minimize penetration. The chemical resistance of common glove materials varies according to the glove manufacturer, as manufacturers may vary the thicknesses and formulations of materials. General guidelines to the selection and use of protective gloves:

- Do not use a glove beyond its expiration date. Gloves degrade over time, even in an unopened box.
- When not in use, store gloves in the laboratory space but not close to volatile materials. Do not don or doff gloves in offices, in break rooms or lunchrooms.
- Inspect gloves for small holes, tears, and signs of degradation before use.
- Replace gloves periodically because they degrade with use, depending on the frequency of use and their permeation and degradation characteristics relative to the substances handled.
- Replace gloves immediately if they become contaminated or torn.
- Decontaminate or wash gloves appropriately before removing them. [Note: Some gloves, e.g., leather and poly (vinyl alcohol), are water permeable. Unless coated with a protective layer, poly (vinyl alcohol) gloves will degrade in the presence of water.]

- Gloves on a glovebox should be inspected with the same care as any other gloves. Disposable gloves appropriate for the materials being handled within the glovebox should be used in addition to the gloves attached to the box. Protect glovebox gloves by removing all jewelry prior to use.

Table 5.3.1 Properties of Protective Clothing Materials

MATERIALS	STRENGTH	CHEMICAL RESISTANCE	FLAMMABILITY	STATIC PROPERTIES	COMFORT	USES
COTTON	Fair durability	Degraded by acids; binds	Special treatment for flame	No static problems	Comfortable, lightweight	Lab coats
MODACRYLIC	Resistant to rips and tears but less so than polyamide fibers; abrasion-resistant but less so than nylon or polyester	Resistant to most chemicals	In direct flame, fabric shrinks to resist flame penetration; will not melt or drip; self-extinguishing; rapidly dissipates when source of ignition is removed	Has antistatic properties	Comfortable, soft, and resilient; easy to clean; has soil release properties	Lab coats
NYLON	Exceptionally strong and abrasion resistant	Not water absorbent	Melts when heated; requires flame retardant	Static buildup possible; requires antistatic agent	Lightweight	Lab coats
PLASTIC	Usually reinforced at points of strain; will not stick together, peel, crack, or stiffen	Resistant to corrosive chemicals	Can be ignited by flammable solvents and others in event of static discharge	Accumulates considerable charge of static electricity	Lightweight	Aprons, sleeve protectors, boots
POLYOLEFIN	Resistant to rips and tears	Excellent chemical resistance; low binding for chemicals	High melting point; flame-resistant	Good static dissociation	Lightweight; good permeability; limited moisture absorbency; wearer perspiration may cause discomfort	Bouffant caps
POLYPROPYLENE	Strong	Resistant to most chemicals; oxygen and light-sensitive	Low melting point; requires flame retardant	Static buildup; requires antistatic agent	Lightweight	Aprons
RAYON	Fairly durable			Degraded by acids; binds some chemicals		Lab coats

Joint Committee on Administrative Rules
ADMINISTRATIVE CODE

TITLE 32: ENERGY
CHAPTER II: ILLINOIS EMERGENCY MANAGEMENT AGENCY
SUBCHAPTER b: RADIATION PROTECTION

PART 315 STANDARDS FOR PROTECTION AGAINST LASER RADIATION
SECTION 315.100 GENERAL OPERATOR REQUIREMENTS

Section 315.100 General Operator Requirements

a) Administrative and Procedural Controls

1) The registrant shall provide personnel operating lasers written operating and safety procedures. These procedures shall include restrictions required for the safe operation of each laser and shall include the topics listed in the laser safety program of subsection (a)(2).

AGENCY NOTE: Sample standard operating procedures for the use of laser systems are contained in Appendix A. The Agency recommends these procedures be modified and adopted for each registrant's specific use of lasers.

2) The registrant shall provide for initial and annual in-service training in laser safety for individuals using laser systems to ensure their awareness of the registrant's laser safety practices and policies. The in-service training shall include the following topics:

A) Operating and emergency procedures for the lasers;

B) Use of laser protective devices, including selection and use of protective eyewear;

C) Clear warnings and precautions to avoid possible exposure to laser radiation in excess of the MPE; and

D) Requirements for safe operation of lasers as described in this Part.

3) Personnel operating lasers shall be instructed in and able to demonstrate competence with the registrant's operating and safety procedures.

4) Alignment of laser optical systems (e.g., mirrors, lenses and beam deflectors) shall be performed in a manner that assures that no one is exposed to laser radiation above the MPE.

5) A controlled area shall be established when exposure to laser radiation in excess of the MPE limit is possible. The controlled area shall meet the following requirements:

A) Be posted as required by Section 315.150.

B) Access shall be only by permission of the laser safety officer or a trained designated representative.

6) Unenclosed Beam Paths

A) An evaluation of the expected beam path and the potential hazards from reflective surfaces that may be encountered shall be conducted before operating the laser. All reflective surfaces shall be excluded from the beam path at all points where the laser radiation exceeds the MPE.

B) If applicable, the stability of the laser platform shall be evaluated to determine the constraints that shall be placed upon the beam traverse and the extent of the range of control.

C) No laser shall be operated or made ready for operation until the area along all points of the beam path where the laser radiation will exceed the MPE is clear of individuals, unless the individuals are wearing appropriate protective devices.

b) Requirements for Safe Operation

1) Operator Supervision

A) The laser system shall be operated at all times under the direct supervision or control of an experienced, trained operator who shall maintain visual surveillance of conditions for safe use and terminate laser emission in the event of malfunction or any other condition of unsafe use.

B) Unattended use of the laser system shall be permitted only when the laser safety officer has implemented appropriate control measures that provide adequate protection and laser safety training to those who may enter the laser controlled area during times of unattended

use.

2) Maximum Permissible Exposure (MPE)

A) No individual shall be exposed to levels of laser radiation higher than the MPE, as described in Tables A and B.

B) In those cases in which MPE is known for particular wavelengths and pulse durations, exposure to laser radiation shall be prohibited.

C) Measurements and calculations performed to determine MPE limits shall be made in a manner consistent with the criteria contained in ANSI Z136.1-2000.

3) The minimum laser radiant energy or laser power level required for the application shall be used.

4) All service procedures shall be performed by qualified personnel who are trained in laser radiation protection.

5) Protective eyewear, when specified by the laser safety officer, when engineering or other procedural and administrative controls are inadequate to eliminate potential exposure in excess of the applicable MPE, shall be worn by all individuals with access to Class 3b and Class 4 levels of laser radiation. The protective eyewear devices shall meet the following requirements:

A) Provide a comfortable and appropriate fit all around the area of the eyes sufficient to protect the eyes from laser radiation.

B) Be in proper condition to ensure the optical filters and holder provide the required optical density or greater at the desired wavelengths, and retain all protective properties during use of the device.

C) Be suitable for the specific wavelength of the laser and be of optical density adequate for the energy of the laser.

D) Have the optical density or densities and associated wavelengths permanently labeled on the filters or otherwise permanently identified.

E) Be examined by the registrant's laser safety officer, or designee, at intervals not to exceed 6 months, to ensure the reliability of the protective filters and integrity of the protective filter frames.

F) Eyewear not meeting the requirements of this subsection (b)(5) shall

not be utilized as protective eyewear.

6) When there is a possibility of exposure to laser radiation that exceeds the MPE limits for skin as specified in Table B, the registrant shall require the appropriate use of protective gloves, clothing and shields.

7) Laser products certified by a manufacturer to be compliant with the requirements of 21 CFR 1040 applicable at the date of manufacture shall be maintained in compliance with the requirements. Certified laser products that have been modified shall comply with this Part.

c) Engineering Controls

1) Each laser product shall have a protective housing that prevents, during operation, human access to laser radiation that exceeds the limits of a Class 1 laser (see 21 CFR 1040.10, Table I), wherever and whenever human access is not necessary in order for the laser system to perform its intended function.

2) Safety Interlocks

A) A safety interlock, which ensures that laser radiation is not accessible above MPE limits, shall be provided for any portion of the protective housing that, by design, can be removed or displaced without the use of tools during normal operation or maintenance.

B) Adjustment during operation, service, testing or maintenance of a laser containing interlocks shall not cause the interlocks to become inoperative or the laser radiation to exceed MPE limits outside the protective housing except where a controlled area, as specified in subsection (a)(5), is established.

C) For pulsed lasers, interlocks shall prevent firing of the laser.

D) For continuous wave lasers, the interlocks shall turn off the power supply or interrupt the beam.

E) An interlock shall not allow access to laser radiation in excess of MPE limits when the interlock is closed.

F) Multiple safety interlocks, or a means to preclude removal or displacement of the interlocked portion of the protective housing upon failure, shall be provided if failure of a single interlock would allow human access to levels of Class 3b or Class 4 laser radiation.

3) Viewing Optics and Windows

A) All viewing ports, viewing optics or display screens included as an integral part of an enclosed laser or laser system shall incorporate suitable means to attenuate the laser radiation transmitted through the port to less than the MPE during maintenance or operation of the laser.

B) When optical systems such as lenses, telescopes and microscopes are used that were not supplied as part of a certified laser product, the laser safety officer shall determine the potential hazard and specify administrative procedures and the use of controls such as interlocks or filters.

4) Warning Systems

A) Each laser system shall provide visual or aural indication during the emission of accessible laser radiation.

B) Any visual indicator shall be clearly visible through protective eyewear designed specifically for the wavelengths of the emitted laser radiation.

C) Visual indicators shall be positioned so that viewing does not result in exposure to laser radiation in excess of the MPE.

D) An indication shall be provided prior to emission of the radiation to allow appropriate action to avoid exposure.

5) Additional Requirements for Indoor Class 4 Laser Controlled Areas

A) Latches, interlocks or other appropriate means shall be used to restrict access to controlled areas.

B) Measures shall be designed to allow both rapid exit by the laser personnel at all times and entrance to the controlled area in an emergency condition.

C) For emergency conditions, a control-disconnect switch or equivalent device (panic button) shall be available for deactivating the laser or closing the shutter.

D) During tests requiring continuous operation, the laser safety officer or a trained designated representative shall be permitted to momentarily override the safety interlocks to allow access to other authorized personnel if it is clearly evident that:

i) There is no optical radiation hazard at the point of entry; and

ii) The necessary protective devices are being worn by the entering personnel.

E) Optical paths (e.g., windows) from an indoor facility shall be controlled in such a manner as to reduce the transmitted values of the laser radiation to levels at or below the MPE. When the laser beam must exit the indoor controlled area (as in the case of exterior atmospheric beam paths), the operator shall be responsible for ensuring that the beam path is limited to controlled air space or controlled ground space when the beam irradiance or radiant exposure is above the appropriate MPE.

(Source: Amended at 37 Ill. Reg. 20200, effective December 9, 2013)