DEPARTMENT OF
ENVIRONMENTAL SAFETY,
SUSTAINABILITY & RISK

University of Maryland Laboratory Design Guide

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Scope

The University of Maryland (UMD) laboratory facilities provide a safe and healthy environment for occupants and meet all regulatory standards. As an R1, premier research university, the objective for laboratory design is to enable maximum flexibility in laboratory spaces for current operations and to the extent practical, plan for future growth. Health and safety risks are anticipated and carefully evaluated so that protective measures are incorporated into the design. The Department of Environmental Safety, Sustainability and Risk (ESSR) developed this Laboratory Design Guide (Guide) to aid design professionals, faculty, staff, and other members of the campus community during the planning and designing stage of laboratory spaces. The topics listed in this document encapsulate the basic health and safety design features for use of hazardous materials and performance of hazardous operations in all new and renovated laboratories.

Along with regulatory and code requirements, this Guide highlights recommended and best practices, not defined by regulatory documents. The specific requirements identified by code are cited and shall be incorporated in the design appropriately. Each laboratory design must be evaluated by ESSR as defined in the *Design Review and Approval Process* section of this document. For college coordinators responsible for assigning new faculty to laboratories, a general understanding of the limitations of that laboratory should be discussed with ESSR prior to space assignments. Limitations to research due to building construction type, ventilation capabilities, and chemical limitations depending on floor level should be known prior to assignment.

This Laboratory Design Guide applies to hazardous materials and hazardous operations within all new laboratory and laboratory support room renovations and construction projects at UMD. This includes laboratory renovations and construction projects under the purview of UMD lead project managers located at UMD College Park Facilities Management and college managed project managers. Projects initiated after the Effective Date of publication, shall comply with this Guide. This Guide will be periodically updated to incorporate new regulations and best practices, making it essential to reference and apply the latest revisions available at the time of design.

Recognizing that the University of Maryland is a research institution with innovative and uncommon types of research or experiments being considered, additional Environmental Health and Safety (EH&S) issues may need to be addressed outside of this Guide, for a particular project.

Vivarium and spaces where research animals may be used or cared for, are out of the scope of this Guide. In these cases, consult the standards outlined in the UMD Facilities Management Design Criteria/Facilities Standards (DCFS).

How To Use Guide

As a part of the renovation/construction process, ESSR staff in the Office of the Fire Marshal (OFM) and Office of Research Safety (ORS) must review and approve all laboratory designs, construction documents, and specialized equipment being connected to building utilities. The *OFM Comprehensive ESSR Plan Review & Inspection Process* Flow Chart depicts this approval process by OFM, which is the authority having jurisdiction (AHJ) on the University campus.

OFM and ORS use a combination of National Fire Protection Association (NFPA), International Building Code (IBC), Occupational Safety and Health Administration (OSHA), American National Standards Institute (ANSI), International Mechanical Code (IMC), Code of Federal Regulations (CFR), Code of Maryland Regulations (COMAR), and other various codes/standards as designated in the DCFS. Therefore, any deviation from the requirements in this Guide must be documented and reviewed by OFM or ORS staff (see *Deviations From Guide* section).

Within the Guide, the following expectations apply:

> ***Required:*** Mandatory design elements for compliance with regulations and regulatory code.
>
> ***Recommended:*** Strongly encouraged design elements to mitigate known health and safety risks within research laboratories.
>
> ***Best Practice:*** Considerations to enhance laboratory operations, flexibility, and future growth.

To ensure the review process does not cause delays in construction, the Needs Assessment Checklist should be provided to ESSR in the Design Development (DD) phase of the project. See *OFM Comprehensive ESSR Plan Review & Inspection Process* Flow Chart.

When renovation/construction work is completed, the OFM shall be contacted to complete a final walkthrough to ensure the project has been completed according to the plan and that no safety issues are present. Once completed, the OFM will issue a Certificate of Occupancy for users to occupy the laboratory space.

General Laboratory Design

Laboratory Layout

Discussion with the School/College/Department leadership and lab principal investigator(s) (PI) must define the plans for research activities, the hazards, materials, and equipment that will be present. Understanding the laboratory operations (including throughput/volumes, number of personnel) will support designing for current and future research growth.

Required

- Laboratories that use and store limited amounts of chemicals, less than or equal to one (1) gallon of flammable or combustible liquid or 75 standard cubic foot (scf) of flammable gas, are NOT considered laboratories under NFPA 45. [NFPA 45 Section 1.1.3.1]
- Depending on the classification of the laboratory and floor level, non-laboratory areas shall be separated with a rated wall per Table 5.1.1 from laboratory spaces. [NFPA 45 Section 5.1.1]
- Higher risk work areas, such as chemical fume hoods or compressed gas storage areas, shall be placed as far from the laboratory exits as feasible. [NFPA 45 Section 7.9]
- Ventilation shall be provided to ensure that airflow shall be from areas of low hazard to higher hazard. Permanent office spaces (not laboratory workstations) must have their main entrance to a hallway to prevent unnecessary travel through laboratory spaces. [ANSI Z9.5 Section 5.2.1]
- By federal regulation, regulated waste must be stored in the lab in which it is generated, not in centralized accumulation areas defined by 40 CFR 260.10. [NFPA 45 Section 8.3] Centralized accumulation areas have to be registered with the EPA and would require significant waste handling procedures by end users. Approval from ESSR Office of Environmental Affairs would be required.
- The location of chemical storage areas must be proximal to the location of expected work to reduce travel with hazardous material through the open lab. [NFPA 45 Section 5.3]
- To accommodate ESSR's Office of Environmental Affairs' (OEA) laboratory waste pick-ups, adequate and dedicated space must be provided within each contiguous lab for the lab's anticipated waste storage. [40 CFR Part 262]
- All aisles and normally occupiable spaces must have minimum 36 inches of clearance for emergency egress. [DCFS 01.81.10 and ADA 403.5]
- If emergency lighting is required, emergency lights need to be properly spaced to provide light coverage to higher hazard areas. [NFPA 45 Section 5.5.3]
- If experiments or research requires specialized light schedules or brightness limits, discuss with the OFM regarding additional requirements for the space. [AHJ approval]
- If an autoclave is being considered or required, the location and room requirements must be adequate for the device being considered. ESSR shall be notified during installation to coordinate testing and registration with the State of Maryland regulatory agency. [COMAR 09.12.01]
- Storage and consumption of food and drink unrelated to research processes are prohibited in laboratories. Kitchen/food preparation areas are also prohibited within the laboratory footprint. [UMD Research Safety Standard]
- Conditions or experiments that create confined spaces requiring a confined space entry permit must follow OSHA standards, and notification and permit from ESSR. [OSHA 1910.146(b)]

Required (cont.)

- Depending on laboratory equipment (e.g., heavy laser tables, aquatic tanks, heavy machinery, etc.) or safety requirements (e.g., sand filled concrete blocks), a structural engineer may need to review room/building support design to ensure the weight does not compromise structural integrity of the building.
- Install the State Fire Prevention Code maximum allowable quantity (MAQ) placard inside each laboratory at the primary entrance to the lab. OFM will provide placard based on room details which will need to be confirmed by the project manager (PM). [COMAR 29.06.01.08 (YY) 26.1.5.4]

Recommended

- Placement of moveable furniture (e.g., bookcases, equipment stands, cylinder racks, push carts, etc.), experimental equipment, and refrigerators is not recommended near emergency equipment (which have required clearances) and egress pathways as they may impede egress if moved.
- When designing lighting layouts, work with the lab personnel to ensure that access for lightbulb or fixture changes will not be impeded by hazardous materials, equipment, and/or casework.
- The dedicated waste storage space should be proximal to the chemical use areas and not adjacent to any floor drains or egress exits.

Best Practice

- In standard laboratory types, aisles between benches, work surfaces, and equipment should be a minimum of 5 feet. [Guidelines for Laboratory Design – 4th edition]
- Laboratories should be designed to conveniently and safely accommodate the temporary storage of biological, radiological, and chemical wastes based on laboratory use projections.

Materials/Finishes

Required

- For laboratories containing hazardous materials (chemical, biological, or radiological), materials and finishes used for furniture and casework should be smooth and non-porous so that decontamination can be achieved in the case of a spill. [NFPA 45 Section 5.1.5]
- Flooring shall be installed and sealed to prevent liquid leaking to lower floors. [NFPA 45 Section 5.1.5]
- Floors should be curved up on walls and cabinet bases to ensure spills cannot penetrate underneath floors/cabinets. [NFPA 45 Section 5.1.5]
- All openings in floors and walls, including areas above ceiling tiles, should be smoke tight or fire stopped depending on wall/separation fire rating. If penetrations are found during renovations, the project manager must have contractors repair or fix while the area is under construction to bring the room up to applicable code. [NFPA 45 Section 5.1.4]

Required (cont.)

- Cabinets meant for the storage of corrosive chemicals shall be designed for that purpose (e.g., lined with polyethylene, minimal metal components, spill catch pan). Cabinets meant for the storage of flammable chemicals must meet current NFPA construction requirements and are required for any use of flammable chemicals. [NFPA 30 Section 9.5]
- Ventilation of chemical storage cabinets is not required, but if desired for odor control, must meet specific cabinet construction guidelines. Combustible material is not permitted to be used for ventilation piping [NFPA 91 Section 4.2]
- All piping behind casework, above ceiling tiles, and other areas not normally exposed shall be labeled. Examples include natural gas, vacuum, water lines (hot and cold) and compressed air lines. [DCFS 23.00.05]
- Zip ties and other support type wiring (temporary or permanent) shall not be attached to sprinkler piping during construction. Piping shall be permanently secured per installation specifications and temporary supports shall be removed before final inspections by the OFM. [NFPA 13]

Recommended

- Carpeting should not be installed in lab, lab support, clinical, and related work areas. Carpeting is hard to clean/disinfect/decontaminate, serves as a reservoir/source of dust and microorganisms, and once wetted, becomes a potential habitat for mold and bacteria.
- Countertops should be heat/chemical resistant.
- In labs with fume hoods, at least one cabinet for corrosive and one cabinet for flammable liquids, either below the fume hood or in the room, should be available.
- Windows in laboratories should be non-operable or closed off completely, if necessary, to control ventilation and provide a secure research environment.

Best Practice

- There are several different finishes for work surfaces and each type should be selected based on current and future needs of the space. The most common finishes are epoxy resin cast, chemical resistant laminate, and stainless steel.
- Sealed wooden bench tops are not recommended for certain types of labs because overtime, sealant can break down and unfinished wood surfaces can absorb liquids. Additionally, wood burns rapidly in the event of a fire.
- Fiberglass is not recommended and should be replaced as it can degrade when strong disinfectants are applied. Fiberglass will also release toxic smoke in the event of a fire.
- Walls should be painted with washable, non-porous paints. [National Institutes of Health (NIH) Design Requirements Manual (DRM)]

Laboratory Security

Required

- All laboratories must have a lockable door at the primary access to the space.
- For labs requiring a secondary exit, avoid using adjoining labs as an egress pathway, especially when known hazardous or regulated materials are being considered for use in those spaces. [OSHA 1910.36(e)(2)] If future use of adjoining lab changes, egress may not be permitted.

Recommended

- Swipe card or proximity reader access for laboratory spaces is highly recommended to improve security. If no swipe card or proximity reader is available, a lock with a high security core should be used to lock doors accessible to public hallways.
- Primary entry doors from public hallways should not have a large door louver near the base of the door.

Best Practice

- Consider security and the potential risk levels of research over time involved before creating shared collaborative labs with little/no ability to divide or secure spaces. Sensitive research areas (e.g., controlled substance laboratories, animal rooms, radioactive materials labs) may require additional security measures (e.g., security cameras). Discussions about installing security cameras should include University of Maryland Building Security Systems (BSS).

Ergonomic Considerations

Best Practice

- The type, location, and height of workstations and equipment should be considered when it comes to laboratory personnel ergonomics. Countertop heights and seating should be designed for personnel to work without unnecessary strain on their bodies.
- Provide knee space panels to allow seating at the bench to complete work. Countertops and overhead storage near bench cutouts should be designed to limit reaching by personnel while sitting or standing at one location.
- For lab renovations, ESSR can provide evaluations and recommendations to the design team.

Plumbing

Required

- Laboratories that contain hazardous materials (chemical, biological, or radiological) shall have facilities for handwashing within the laboratory footprint. [OSHA 1910.1450]
- Where the eyes or body of any person may be exposed to injurious corrosive materials, quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. See **Emergency Systems** section for more details on emergency shower and eyewash requirements. [OSHA 1910.1519(c)]
- Back-flow prevention (anti-siphon) devices are required by Washington Suburban Sanitary Commission (WSSC) on all laboratory sink installations and fixed water consuming equipment. [2018 WSSC Plumbing & Fuel Gas Code Section 505]
- Disposal of any chemicals down any type of drain on campus is prohibited unless the laboratory has a signed approval from ESSR. [2018 WSSC Plumbing and Fuel Gas Code Section 505 & ESSR approval]
- Laboratories that involve the sampling, handling, or use of biological materials shall have a sink to wash hands within the room. This includes all labs designated as Biosafety Levels (BSL) 1 through 4. [NIH DRM & Center for Disease Control and Prevention (CDC)]
- BSL laboratories handwashing sink shall be located near the exit door. [Biosafety in Microbiological and Biomedical Laboratories (BMBL), CDC, and NIH]

Best Practice

- BSL laboratory sinks for handwashing should be able to be operated without hands-free or automatically operated type, location

Ventilation

General Design Details

Required

- All laboratories and operations that produce airborne hazards must be appropriately controlled by use of mechanical ventilation so that users do not have to wear any type of air purifying respirator for normal operations. [OSHA 1910.134]
- The heating, ventilation, and air conditioning (HVAC) system shall meet requirements of University of Maryland Facilities Management Design Considerations for HVAC Systems and On-Call General Contractors Specs. [DCFS 23.00.02 & On-Call General Contractors Specs – Section 233113]
- The ventilation design must be coordinated and reviewed by UMDs Central Control and Monitoring System (CCMS) and ESSR.

Recommended

- Consider the dynamic nature of experiments and provide spare capacity to accommodate additional local exhaust ventilation installations anticipated in the future. In addition, laboratory ventilation in all newly constructed buildings and renovated spaces shall meet the requirement of ANSI Z9.5-2012 *Laboratory Ventilation* and be designed or customized for the laboratory use.

Laboratory Supply and Exhaust Ventilation

Laboratory Ventilation System Design

Required

- Provide access for maintenance, adjustment, testing, or repair by the University Facilities Management or third-party vendor. [ANSI Z9.5 Section 5.4.4]
- If the HVAC designer is considering chilled beam or fan coil units for recirculation in the lab, ensure that the room maintains negative pressure to surrounding areas to maintain the flow of ventilation from low hazard areas to high hazard areas. [NFPA 45 Section 7.3.1]
- HVAC internal duct linings and coatings that may accumulate chemical residues/deposits (e.g., fiberglass, foam) are not permitted in laboratory exhaust systems. Additionally, local exhaust ventilation (LEV) ductwork must be constructed of noncombustible materials. [ANSI Z9.5 Section 5.4.2.2]
- For laboratories that do not fall under the scope of NFPA 45 or NFPA 55, ventilation systems should be designed to protect laboratory occupants of potential hazards.

Supply Air

Required

- Provide continuous single-pass, non-recirculated ventilation that must maintain a negative pressure (typically 0.02 - 0.05 inch of water (in H_2O)) to adjacent hallway/office/non-laboratory areas. Note: pressure differentials exceeding 0.10 in H_2O could make it difficult to open doors. Any exemptions to this must be approved by the AHJ. [NFPA 45 Section 7.3 & ANSI Z9.5 Section 5.4.7]

Required (cont.)

- In the case of clean rooms, where positive pressure is needed, an antechamber, or equivalent, must be designed so that the antechamber is negative to the laboratory and negative to the hallway. [ANSI Z9.5 - 5.2.1]
- Direction of airflow shall be from low hazard (corridors and offices) to high hazard areas (labs and equipment rooms). [ANSI Z9.5 5.4.7]
- Choose locations, type, and number of supply air diffusers so as not to compromise performance of fume hoods or other LEV systems. In certain situations, three-way or two-way diffusers should be installed to stop airflow in directions that could affect face velocity issues with fume hoods. [NFPA 45 Section 7.3.4]

Recommended

- Heating, cooling, and humidity controls should consider effective operation of laboratory equipment in addition to the comfort of laboratory occupants.

Best Practice

- To create optimal airflow management within a laboratory, choose diffusers (e.g., louvered, slotted, laminar, radial) that can increase effective air exchange rate in the space.
- All laboratories should be designed so that at least six (6) air changes per hour (ACH) is achievable. Laboratories that do not use or store any hazardous materials can be adjusted to four ACH or less with ESSR approval.

Exhaust Ventilation

Required

- Laboratory ventilation systems shall be designed to ensure that chemical fumes, vapors, or gases originating from the laboratory shall not be recirculated. [NFPA 45 Section 7.3.1]
- Provide appropriate exhaust ventilation for the chemicals, operations, and processes in the laboratory. Contaminants should be controlled and captured at the source with local exhaust ventilation when possible. Hazardous exhaust systems shall continuously ventilate under normal operating conditions. [NFPA 45 Section 7.2]
- A hazardous exhaust system is required if more than 25% of the lower flammability limit (LFL) or 1% of median lethal concentration (LC50) of the material can be exceeded without an exhaust ventilation system. [IMC Section 510.2]
- Mechanical exhaust shall be provided at a rate of not less than 1 cfm/ft^2 over the laboratory area in laboratories where chemicals are used and/or stored. [IMC 502.8.1.1]
- Minimum exhaust ventilation rate for an occupancy classified as science laboratories shall be 1.0 cfm/ft^2. [IMC Table 403.3.1.1]
- Where exhaust ductwork is located inside the building, the exhaust system shall have a lower static pressure with respect to the surrounding rooms to prevent air from leaking out of the duct into the building. [ANSI Z9.5 Section 5.4.3.6 & 5.4.6]

Required (cont.)

- Exhaust fans shall be located physically outside of laboratory building or in roof mechanical space in a manner that the location minimizes the risk of personnel coming into contact with exhaust airflow. [ANSI Z9.5 Section 5.4.4]
- Laboratory LEV exhaust must be discharged above the roof at a location, height, and velocity to prevent re-entrainment or roof worker exposure. The discharge location should consider the location of the air intakes for the building and nearby buildings. [ANSI Z9.5 Section 5.4.6]
- Exhaust duct velocities must be high enough to minimize deposition of liquids/solids in normal operation.
- Exhaust fans used for laboratory exhaust must be selected to meet requirements for fire, explosion, and corrosion proofing. [NFPA 45 Section 7.5 – 7.7]

Recommended

- Exhaust fan unit location and operation should not generate excessive noise. Noise treatment shall be provided for sound pressure level (SPL) in conformance with local ambient noise criteria.
- Fume hoods are not recommended to be the sole means of room air exhaust.
- Lab designers should discuss and evaluate the heat loading for laboratories that will be operating pieces of equipment that generate excessive heat. The HVAC system may need to be designed to manage excess heat from certain pieces of equipment to maintain a comfortable working environment.

Best Practice

- Laboratories that do not use or store any hazardous materials can be adjusted to four ACH or less with ESSR approval. Energy conservation projects that involve laboratory spaces must be discussed and evaluated by ESSR to ensure appropriate ventilation is maintained to protect room occupants.

Local Exhaust Ventilation

Snorkel Exhaust Systems

Required

- Installation of snorkel exhaust systems for use other than heat extraction must be reviewed and approved by ESSR to guarantee the airflow is sufficient for proposed use.
- If a snorkel exhaust is being added to an existing system, a testing, adjusting, and balancing (TAB) survey shall be completed to confirm that other exhaust systems can handle the additional variability and still maintain adequate exhaust protection. [ANSI Z9.2]
- Snorkels should have the capability of achieving a face velocity of between 50-200 feet per minute (fpm) depending on the planned use. [NFPA 45 Section 7.4.8]

Best Practice

- Snorkel exhaust intake should be designed to be able to reach the point source as it will be susceptible to inefficient capture the farther from the point source it reaches.
- Snorkel arms should include an accessible shutoff damper switch to stop flow when device in not in use.

Canopy Hoods

Required

- Canopy hoods shall only be used for means of heat extraction. Canopy hoods are not allowed to ventilate airborne hazards including, but not limited to, welding fumes, dust, or chemical vapors. [NFPA 45 Section 7.4.9]

Best Practice

- Work areas should not be designed to be located under a canopy hood as canopy hoods draw contaminants past the breathing zone of laboratory personnel.
- Autoclaves should have canopy hoods to help control heat and steam release when opened.
- Follow equipment recommendations or requirements regarding connection to LEV exhaust systems.
- Ceiling diffusers should be adjusted to limit airflow towards canopy hood intakes.

Gloveboxes

Required

- A hazard assessment shall be completed prior to selection and the glovebox product data sheet shall be submitted to the ESSR. Hazard assessments can be completed by outside consultants. [ANSI Z9.5 Section 4.1.2]
- Gloveboxes that store materials that are airborne hazards that need to be vented must be tied into a laboratory exhaust system. [ANSI Z9.5 Section 4.1.6]
- When highly toxic or infectious material is used in a glovebox, exhaust air should pass through scrubbers or other treatment before combining with a LEV system. [ANSI Z9.5 Section 4.1.7] Maintenance and replacement of scrubbers shall be in accordance to manufacture requirements.
- Pressure relief valves must be in-line with the exhaust ventilation. [ANSI Z9.5 Section 4.1.9]

Best Practice

- Gloveboxes are unaffected by airflow cross drafts; however, placement should not be in high traffic areas in relation to the glove ports and transfer airlock.
- If the glovebox is to be filled with a gas, additional safety precautions may be required for the storage of the gas cylinders (e.g., gas cabinet, fire barriers, additional ventilation near floor, etc.).
- Depending on research, consider connecting power source to an emergency power circuit.
- If the glovebox is connected to a point exhaust duct, include a differential pressure Magnehelic® to ductwork to ensure exhaust ventilation is operational.

Gas Cabinets

Required

- Cylinders of gases that are greater than lecture bottle size (2 cubic feet) and have NFPA health ratings of 3 or 4, or a health rating of 2 without physiological warning properties, shall be stored in approved continuously mechanically ventilated, sprinklered gas cabinets. [NFPA 45 Section 10.1.4.3]
- Cylinders of pyrophoric gases that are greater than lecture bottle size shall be kept in approved continuously mechanically ventilated, sprinklered gas cabinets. [NFPA 45 Section 10.1.4.4]
- Cylinders of toxic, highly toxic, and pyrophoric gases shall be stored in gas cabinets that are internally sprinklered. [NFPA 55 Section 6.17.3]
- Gas cabinets shall not contain more than three cylinders, containers, or tanks. [NFPA 55 Section 6.17.4]
- The gas cabinet shall be provided with self-closing limited access ports or non-combustible windows to give access to equipment controls as well as self-closing access doors. [NFPA 55 Section 6.17.1]
- The gas cabinet shall be provided with an exhaust ventilation system designed to operate at a negative pressure relative to the surrounding area. [NFPA 55 Section 6.18.1]
- The velocity at the face of access ports or windows, with the access port or window open, shall not be less than 200 ft/min (61 m/min) average, with not less than 150 ft/min (46 m/min) at any single point. [NFPA 55 Section 6.18.1.1]
- Gas detection shall be provided for the indoor use and storage of toxic and highly toxic compressed gases. [NFPA 55 7.9.6]
- Activation of the gas detection system shall shut down the flow of gas to the system. [NFPA 55 Section 7.9.6.4]
- The gas detection system shall initiate a local alarm that is both audible and visible. [NFPA 55 7.9.6.2]

Fume Hoods

General Details

Location

Required

- Chemical fume hoods shall not be located adjacent to a single means of access to exit. [NFPA 45 Section 7.9. 2]
- Fume hoods must be located in areas with limited foot traffic and away from any windows or doors to limit air turbulence. [NFPA 45 Section 7.9.1]
- Workstations, specifically casework designed for chairs, shall not be located in front of fume hood openings unless work at station is directly related to the fume hood activity. [NFPA 45 Section 7.9.3]

Design and Construction

Required

- ESSR shall be notified via the ESSR needs assessment checklist of the installation or relocation of any chemical fume hoods or any type of modification of existing fume hoods that could cause airflow changes (e.g., addition of duct to existing system, duct modification of any sort, new sash, general room ventilation changes, etc.).
- All chemical fume hoods must comply with requirements in UL 1805, Standard for Safety Laboratory Hoods and Cabinets. [NFPA 45 Section 7.8.1.2]
- New chemical fume hoods being installed shall operate continuously when in use and where required to maintain minimum ventilation rates and room pressure control. New fume hoods should not be installed with on-off switch accessible to users. [NFPA 45 Section 7.2.2 and ANSI Z9.5 Section 5.4.3.9]
- Chemical fume hood exhaust fans are required to be connected to an emergency power system in the event of a power failure for laboratories using compressed gases. Emergency power circuits should be designed for fans to automatically restart upon restoration after a power outage and supply at least half of the normal airflow. [NFPA 55 7.9.5.3]
- Fume hood exhaust duct material and installation shall be in accordance with the current version of ACGIH Industrial Ventilation: *A Manual of Recommended Practice* and American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Handbook.
- Automatic fire dampers shall not be installed in a laboratory fume hood exhaust system. [NFPA 45 Section 7.5]
- Fume hood exhaust ducts from each laboratory unit must be separately ducted to a point outside the building, to a mechanical room, or to a shaft. [NFPA 45 Section 7.5.10.1]
- Chemical fume hoods must be installed with an airflow alarm system. [ANSI Z9.5 Section 3.3.3]
- Low flow alarms shall be designed to be both visual and audible.
- Written approval from ESSR's Chemical Hygiene Officer is required if flow is to be outside 80-120 linear FPM.
- All chemical fume hoods must be tagged with an UMD Facilities Management tracking barcode and input into the University HVAC Building Automation System (BAS).
- Exhaust systems shall be resistant to corrosion by the agents to which they are exposed. [ANSI Z9.5 Section 5.4]
- The discharge of any fume hood exhaust shall discharge at a minimum of 10 feet above adjacent roof lines, air intakes, and in a vertical up direction. [ANSI Z9.5 Section 5.4.6]
- Lab operations (e.g., digestions) involving large volumes of open and/or heated hydrofluoric acid (HF) requires a non-glass sash to avoid etching and retain transparency.
- Fume hoods designated as radioactive hoods, refer to the "Specialized Laboratories" section for requirements.

Recommended

- If exhaust in on emergency power, emergency power for supply air should be evaluated as to not create a vacuum in the laboratory. [NFPA 45 7.2.5]
- To prevent significant delays in repairs and maintenance, discussion with the FM Fume Hood Shop should be done prior to fume hood selection so that type of hood is consistent with what is common on campus.
- Based on planned chemical research, duct construction material should be discussed with the UMD Fume Hood Shop and ESSR for compatibility. It is recommended that 304 stainless steel is used due to its corrosion, impact, and vibration resistance. Exhaust ducts serving hoods with planned radioactive materials, volatile solvents, and strong oxidizing agents (perchloric acid) be fabricated with 316 stainless steel. Stainless steel ductwork is preferred to be 16-gauge, but 18-gauge is acceptable.
- Rigid plastic ductwork is recommended for fume hoods that are planned to use significant volumes of acids due to the corrosion resistance; however, plastic is brittle and less resistant to vibrations and accidental impacts anywhere on the duct system. The decision to use rigid plastic over stainless steel should be carefully considered early in the design phase of the project.
- Fume hoods that are planned to be used for acid digestion should have sashes made of plastic (e.g., Lexan) instead of glass.

Best Practice

- Laboratory fume hood exhaust ventilation may be constant or variable air volume depending on planned use and energy efficiency requirements for the space or building set by the University of Maryland.
- Depending on the type of experiment, consider if an emergency purge feature is necessary in case of emergency within the hood.

Commissioning and Testing

Required

- New, modified, and existing fume hoods must be ASHRAE 110 certified as part of the project and cannot be used until the project is completed. Commissioning requirements must be coordinated and financed through the installation project. If modifications of the fume hood exhaust system affect other laboratory systems, testing, rebalancing, and recertification of other laboratories fume hoods will need to be covered by the project. [ANSI Z9.5 6.2.1]
- This commissioning, testing, or retesting is to be done by an ASHRAE 110 capable licensed contractor. [ANSI Z9.5 6.2.2]

Required (cont.)

- A copy of the testing report and FM tracking number (9 digit number) must be emailed to labhood-bsc@umd.edu. [*Please include Building and Room Number*] After the fume hood is commissioned, annual inspections and flow testing will be scheduled by ESSR. The annual testing is coordinated through ESSR and is tracked once the initial testing report and UMD tracking number is uploaded into the tracking system. (The old tracking system used the FHX number and is no longer being used as of 2024)
- Installation of new chemical fume hood systems must comply with the following testing requirements for commissioning:

  i. Commissioning Single Hood constant air volume (CAV) Systems:
     (1) Fan performance tests
     (2) Exhaust duct measurements
     (3) Hood performance tests using ASHRAE 110-2016 method
     (4) Hood alarm calibration
  ii. Commissioning Multiple Hood CAV Systems:
     (1) Fan performance tests
     (2) Verification of proper test, adjustment and balance of branch exhaust flow and static pressures
     (3) Hood performance tests using ASHRAE 110-2016 method
     (4) Hood and system monitor calibration
  iii. Commissioning Variable air volume (VAV) Laboratory Fume Hood Systems:
     (1) Verification of VAV sensor calibration
     (2) VAV hood performance tests using ASHRAE 110-2016 method
     (3) VAV laboratory and ventilation tests
     (4) Verification of system diversity

Perchloric Acid Fume Hood

Required

- Perchloric acid fume hoods and exhaust duct work must be constructed of acid resistant, non-reactive, and impervious materials. [NFPA 45 Section 7.12.2 and ANSI Z9.5 Section 3.2.5]
- The exhaust fan must be acid and spark resistant. [NFPA 45 Section 7.12.3]
- The fan motor must not be located within the duct work. [NFPA 45 Section 7.12.4]
- Drive belts must be conductive and not located within the ductwork. [NFPA 45 Section 7.12.4]
- Ductwork must take the shortest/straightest path to outside of the building, consist of sealed sections, and provide positive drainage slope back into the hood. [NFPA 45 Section 7.12.6]
- Perchloric acid fume hood duct work shall not be manifolded into other exhaust systems. [NFPA 45 Section 7.12.6]
- A water spray system shall be installed for washing down the hood interior and entire exhaust system. [NFPA 45 Section 7.12.8]

Best Practice

- If a chemical fume hood or exhaust system slated for removal during a renovation has a history of perchloric acid use, perchlorate testing must be conducted prior to any demolition work on the system.
- This testing must be coordinated through the project or FM Fume Hood Shop using an ESSR approved vendor/method.
- Removal of perchloric acid fume hoods and associated ductwork should be done only after decommissioning of the fume hood is completed.

Ductless Fume Hoods

Required

- Ductless fume hoods ("ductless enclosures") shall not be used in lieu of chemical fume hoods. Ductless enclosures are only permitted for use with chemicals that have hazard ratings (i.e. health, flammability, and instability) of 0 or 1. [NFPA 45 Section 7.4.9]
- Ductless fume hoods are not allowed to be installed without written approval from both the ESSR Chemical Hygiene Officer and Office of the Fire Marshal. Prior to consideration, a meeting must be scheduled and written standard operating procedures and points of contact must be determined for long-term maintenance and care follow-up.
- Ductless fume hoods shall only be used in laboratories that general exhaust air is not recirculated. [NFPA 45 Section 7.3.1]
- For select operations and chemicals, ductless fume hoods may be permitted. However, users shall submit the *Ductless Fume Hood Request Form* to ESSR for review.
    - Ductless fume hood operations shall only be performed after a hazard analysis and risk assessment has been performed for the specific operations that shall be performed in each ductless fume hood. [NFPA 45 Section 11.4.1.1]
    - Hazard Analysis and Risk Assessment completed by ESSR will include the following:
        - A review of the manufacturer's safety information and operating instructions and a hazard analysis and risk assessment of their impact on the proposed operations.
        - A hazard analysis and risk assessment of the type of filters installed and the manufacturer's statement on the filter media's adsorption capability for the chemicals that will be used in the hood and the filter's expected life.
        - A hazard analysis and risk assessment of the ductless fume hood safety monitoring features, alarm configurations, and potential failure modes and impacts.
        - A hazard analysis and risk assessment of the apparatus and activities permitted in the ductless fume hood, as well as any limitations.
        - Reviewing and approving an emergency plan that includes, at a minimum, conditions under which use of the hood must immediately cease, actions required in the event of a spill in the hood, appropriate response to all alarm conditions, and response to a fire, internal and external to the ductless fume hood.
        - A hazard analysis and risk assessment of the filter replacement plan and schedule.
        - A review of the training plan defining the mandatory training required by users and other laboratory work area occupants.

Recommendations and Campus Specific Concerns

- Ductless fume hoods are not recommended on campus due to the required routine maintenance program that must be established, maintained, and paid for by the laboratory Principal Investigator or Department. Users who do not replace filters and use the ductless fume hood as if it were a normal ducted fume hood place themselves and others in the laboratory at risk of exposure to hazards. Additionally, the FM Fume Hood Shop does not maintain, repair, dispose of filters, or test ductless hoods for compliance.
- Ductless hoods rely on strict administrative controls to ensure users safety.

Energy Conservation

Required

- Enthalpy wheels are allowed for general building air recirculation only and cannot be tied into fume hood exhaust or other hazardous exhaust system. If incorporated, the supply air side shall be positively pressurized with respect to the exhaust air side and purge section is to be incorporated. [IMC 514.2.1]
- Chemical fume hood occupancy sensors that allow the air velocity to decrease below 80 FPM are not allowed unless written approval is obtained (See General Details Section of Fume Hoods)
- Laboratories should be designed to initially operate at 6-10 ACH, with the ability to lower based on a review of laboratory use. [ANSI Z9.5 2.1.3]
- Lab environmental monitoring systems, or the University BAS, are not to be used to adjust and control lab ventilation air change rates below six (6) ACHs unless approved by the ESSR.
- The lowest setback rate programmed for any space containing volatile gases or flammable liquids shall be six (6) ACH. [OSHA 1910.106(d)(4)(iv)]

Recommended

- Occupancy sensors for laboratory spaces should be dual technology with a minimum of two sensors installed with overlapping sensing zones to provide a level of redundancy.
- VAV fume hood systems should be incorporated into new construction whenever possible.
- Use of bypass CAV fume hoods should be limited to renovations where the installed exhaust systems are not able to support VAV fume hood operation.
- If the fume hood is planned to be used for room exhaust, fume hood zone presence sensors should be deactivated to ensure exhaust ACH is maintained while lab personnel are in the lab but not near the fume hood.

*Occupancy setbacks of general dilution ventilation must follow any guidance outlined in the **Ventilation** section of this document.

Emergency Systems

Emergency Rinsing Device Installation

Required

- Newly constructed or renovated laboratories or any room used for similar purposes that will contain any hazardous chemicals or infectious agents, fume hoods, or chemical storage cabinets shall be equipped with one or more emergency eyewashes and showers. [DCFS 01.81.16]
- All emergency eyewash and shower units shall be complaint with ANSI Z358.1 – 2014. Below are select details commonly asked about or found not in compliance.
    - All emergency eyewashes and showers systems shall be installed in accordance with ANSI requirements.
        - If the room requires, or needs, ADA accommodations, ADA compliant emergency shower and eyewash systems shall be installed.
    - Eyewash and safety shower facilities must be within 55 feet of the areas where hazardous chemicals are used.
    - Emergency eyewash and shower equipment shall be located on the same level as the hazard, have un-obstructed access, and require not more than 10 seconds to reach.
        - The "10 second" rule may be reduced depending on the potential effect of the chemical. Where a highly corrosive chemical is used, ESSR will determine the maximum distance an emergency shower and eyewash may be from the hazard.
    - No door shall be between the chemical work area and the emergency eyewash and shower facilities.
    - Emergency devices shall be clearly marked with durable signs secured to the wall or casework indicating the type of device.
    - Disposable personal eyewash bottles and single head drench hoses are considered supplemental safety equipment that are only designed to assist other types of emergency devices (e.g., ANSI approved emergency shower or eyewash stations) but cannot be the only product available to address an emergency situation.

Best Practices

- Emergency systems should not be installed next to sensitive equipment or frequently used power outlets. When choosing placement in the laboratory, maximize distance from potential hazards to prevent creating a hazard when using an emergency system.
- Eyewash units should be installed in such a way that they do not become contaminated from hazardous materials used nearby.
- Eyewash units should not be installed in a location where hands free use is limited due to the unit height or mounting location on casework.
- Emergency eyewash units not located at a sink should be plumbed to a drain if possible. Recessed cabinet and swivel mounted eyewash stations require ESSR approval before selection.

Emergency Rinsing Device Operation

Required

- Emergency shower and eyewash units shall be complaint with ANSI Z358.1 – 2014.
    - Emergency shower minimum volume of discharge should be 75.7 liters/minute (20 gallons/minute) connected to an uninterruptible water supply.
    - The shower shall be designed so that it can be activated in less than 1 second and remain operational without the operator's hand on the valve (or lever, handle, etc.).
    - Eyewash stations must deliver fluid to both eyes simultaneously at a volume of not less than 1.5 liters/minute (0.4 gallons/minute) for 15 minutes. However, the pressure should not be at a velocity that may injure the eyes.
    - Combination eyewash-drench hose units that are third-party certified to meet or exceed the provisions of *ANSI, Z2358.1-2014* are useful in areas where relatively small quantities of injurious materials are handled.
    - Eyewash drench hoses should have tips with two spray heads to enable the unit to wash both eyes simultaneously and do not meet the standard for an emergency shower.
    - Water delivered to each emergency system shall be tepid (60-100°F). In general, water temperatures should be set towards the warmer end (80°-90°F) as these are more suitable conditions if extended periods of eye irrigation or showering are required.
    - Emergency showers shall be installed so that the center of the shower has a minimum of 16 inches of clearance from any obstruction.
    - If an ANSI compliant eyewash-drench hose unit is installed on the side of a sink, the eyewash unit shall be installed oriented towards the counter edge to enable hands free use.
    - Emergency shower area on the ground shall always be clear of storage and equipment for use and annual testing by Facilities Management.

Best Practices

- For testing of combo emergency eyewash and shower units, the drain for the eyewash units should be installed 12-18 inches above the floor.
- Combo emergency shower and eyewash system drain should be oriented into an open space to allow a bucket to be placed under drain.
- For eyewashes installed opposite of countertop sinks, the eyewash unit should be oriented to operate directly over the sink so that water is contained in the sink.
- For swing mounted eyewash stations, demonstration will be necessary to ensure during routine and weekly testing the location does not cause a flooding issue.

Emergency Notification Devices

Required

- Where compressed gas or cryogenic liquid storage has the potential to create an oxygen deficient or enriched environment, below 19.5% or above 23.5% respectively, oxygen monitoring is required. [OSHA 29 CFR 1910.134]

Recommended

- In labs with Class 3b and/or Class 4 laser system(s), safety interlocks should be installed to prevent lab occupants and other building personnel from exposure to lasers. Interlock could be either a lens aperture blocker or laser power shutoff.

Electrical

Required

- Electrical outlets or circuits within six feet of a sink, or other water source, must have GFCI protection. [National Electric Code (NEC) section 210.8]
- Breaker boxes shall be well marked, circuits coded, and centrally located for quick access. [DCFS 26.05.00]
- Any major upgrades to the room power needs should be coordinated with the FM Electric Shop to ensure the existing system can handle upgrades and perform electrical outages as needed to prevent arc flashes when working with the main electrical panel.
- Emergency lighting in laboratories shall be installed. Special considerations can be made for certain research (e.g., animal research, light sensitive research); however, approval from the OFM is required. [International Building Code (IBC) section 1008]
- Any hard-wired equipment not rated by a nationally recognized testing laboratory (NRTL), must be certified in a field test before it can be used in the space. This includes if a piece of equipment is being moved from one lab to another. [OSHA 29 CFR 1910.307(c)]

Recommended

- Electrical outlets shall not be mounted on the floor in areas where emergency showers and eyewash units are present.
- Energized switches (e.g., light switch, thermostats, telecom port, etc.) should not be located near an emergency shower as they could be affected during use or annual testing of the emergency shower.
- Planning should include maximizing the number of separate circuits in a space to avoid overloads. This allows for future researchers and current PIs to switch laboratory configurations with minimal, if any, construction related activities.
- Outlets should be added in areas where power will be needed to avoid the use of electrical extension cords.
- For larger research equipment, equipment shutoffs are recommended to limit electrical panel breaker access and use.
- High value equipment should be tied to emergency/back-up power.

Cryogenic Liquids

Cryogenic liquid is generally stored in dewars, which are insulated, vacuum jacketed, pressurized vessels that require additional ventilation and storage considerations.

Required

- Cryogenic fluids in stationary or portable containers stored indoors shall be stored in buildings, rooms, or areas constructed in accordance with the building code. [NFPA 55 Section 8.13.1.3 / IBC Table 307.1(1)]
- Cryogenic dewars, depending on the fluid, may have quantity limitations for the space. [NFPA 55 Table 6.3.1.1]
- Rooms storing and using cryogenic material shall not have exhaust air recirculated [NFPA 55 Section 6.16.6]
- Exhaust ventilation for the space where a cryogenic liquid is used and stored shall be located within 12 inches of the floor or 12 inches from the ceiling in the vicinity of the tanks. [NFPA 55 Table 6.3.1.1 & IMC 502.8]
- Depending on the type and quantity of liquid cryogen, an oxygen monitoring system shall be installed. [IMC 502.9.3]
- Transportation of cryogenic liquids within buildings poses a potential asphyxiation, fire, and explosion hazard if personnel are trapped in an elevator. Due to the potential hazard, cryogenic fluids should only be transported on service or freight elevators, if labs are not located on the ground floor. [OSHA 29 CFR 1920.134]

Recommended

- Labs that work with cryogenic liquids should be located on the ground level.
- If possible, smaller compressed gas cylinders are recommended over larger cryogenic cylinders.
- To limit waste material to evaporation, consider gas recovery systems or a recovery bladder.
    - If a bladder recovery system is proposed, area surrounding bladder shall meet requirements of bladder manufacturer to prevent damage and ruptures.
    - Where recovery systems are located, oxygen sensors may be needed in the event of a rupture or leak.

Natural Gas Systems

Required

- Renovations that add, modify, or replace any part of the natural gas supply system shall upgrade the system to the current NFPA applicable standards.
- An emergency gas shut-off shall be installed in laboratories that contains two or more gas outlets. [NFPA 54 Section 7.9.2.4]
- Educational and instructional laboratories shall have an emergency gas shutoff in addition to the manual point-of-use valve. [NFPA 45 Section 10.2.3.4]
- The shut-off valve or emergency shut-off device shall be located near the primary means of egress from the space. [NFPA 45 Section 10.2.3.4]
- The quarter turn valve or emergency shut-off button should be labeled with an “Emergency Gas Shutoff” placard. [NFPA 54 Section 7.8.2.4]

Chemical Storage Cabinets

Required

- Flammable and combustible liquids (NFPA Class I, II, and IIIA) shall only be stored in OSHA NRTL approved flammable-liquid storage cabinets. [NFPA 45 Section 9.5]
- Storage cabinets used for the storage of flammable and combustible liquids shall be constructed in accordance with NFPA 30. [NFPA 45 Section 9.5.1]
- Flammable liquid storage cabinets shall be added to spaces that use and store flammable liquids and waste.
- Cabinet shelving should have chemical resistant finish surfaces and be designed to reduce or eliminate accidental falls of containers off the shelves. This is achieved by either the use of shelf edge lip or shelves designed to prevent pass-through forces from other bench side to "push" a bottle off. [NFPA 30]
- The storage cabinet shall not be required to be vented for fire protection purposes. Vent openings shall be sealed with the bungs supplied with the cabinet or with bungs specified by the cabinet manufacturer. [NFPA 45 Section 8.2.4.5]
- If a flammable storage cabinet is vented, it shall be vented directly to a safe location outdoors in such a manner that will not compromise the cabinet and in a manner that is acceptable to the AHJ. PVC or plastic piping shall not be used. [NFPA 30 Section 9.5.4.2]
- Flammable liquids “in use” and “stored” in a laboratory unit shall not exceed the maximum allowable quantities (MAQs) set for the space. If the laboratory does not have a sign designating the MAQs for the space, the OFM should be contacted to review and provide the MAQs. [State Fire Prevention Code 26.1.6.4]]

Recommended

- Laboratory designers should provide basic chemical storage locations and cabinet types in all labs based on planned and future use of the laboratory.
- Storage cabinets should not be located near the primary entrance to the lab.
- Separate below-hood or below-bench flammable and corrosive chemical storage cabinets.
- Chemical fume hoods, bench tops, and unapproved flammable storage cabinets are unacceptable storage locations, even if they have secondary containment. Unapproved flammable storage cabinets may be used for nonflammable liquids and nonhazardous materials.
- Storage cabinets are not required to be grounded by federal regulations but if they are, the grounding wire shall be properly grounded within the space/building.
- Chemicals storage locations should not be installed above eye level or on elevated surfaces.

Cryogen, Gas, and Liquified Gas Storage

Required

- Before any renovation, all hazardous materials/equipment must be removed from the laboratory or otherwise secured in place with approval and acknowledgement of department and contractor prior to demolition and construction work occurring.
- Where one or more gas cylinders are planned to be used, bracket or rack systems should be installed to secure the number of cylinders at that location. These brackets or rack systems should be anchored to a fixed building structure (floor, bench, or wall). [NFPA 45 Section 10.1.5.1]
- Gas cylinder storage is limited to one tank in use and one tank in storage per location. [NFPA 45 Section 10.1.6.3]
- If additional tanks are needed, additional storage should be located in an external location or in a designated storage area or room. [NFPA 45 Section 10.1.6.4]
- If multiple gases are being used for experiments, ensure that the compatibility of the gases meet separation distance requirements. [OSHA 1926.152(a)]
- Gases that have a health hazard rating of 3 or 4, or a health hazard rating of 2 without physiological warning properties shall be stored in approved mechanically ventilated gas cabinets. [NFPA 45 Section 10.1.4.3]
- Gas cabinets, when required for select gases or used to increase MAQs, shall [NFPA 55 Section 6.18]:
    - Operate at a negative pressure to surrounding area.
    - Be internally sprinklered.
    - Not contain incompatible gases.

Recommended

- Compressed gas storage should be as close to the workstation as possible and secured.
- The location of gas cylinders in use and stored shall be discussed with OFM and/or ORS to ensure placement and cylinder safety measures are in place.

Outdoor Gas Storage

Required

- Laboratories are limited to defined volumes of gases dictated by the building construction and fire protection capabilities of a laboratory space. Additional storage of gas cylinders will need to be relocated to a code compliant space within the building or to a designated location outside of the building.
- If large volumes of gas cylinders or cryogenic liquid is needed but unable to be stored inside, PIs must work with Facilities Management on finding outdoor storage areas. Outside storage areas should be covered and shall not be located near storm drains. [UMD National Pollution Discharge Elimination System (NPDES) Permit]
- Gases must be properly separated by distance or fire barrier wall [NFPA 55 Section 7.2.2.2]

Best Practice

- Secondary containment may be required depending on the chemical being stored.
- The storage area should be able to be secured to prevent theft and protected with bollards to prevent damage from vehicles.
- These storage areas should not be located near building egress doors and depending on the hazard may need to be located at a distance from any building or building air intakes.

Laboratory Equipment

Required

- If carts are used within labs, areas for storage of these devices should be accounted for that does not impact egress. [NFPA 101 Section 7.1.10.2.1]
- Follow manufacturing recommendations for equipment. This includes electrical power supply, ventilation, and other safety requirements.

Recommended

- Architects should review planned operations with proposed users to consider any special equipment requirements (e.g., adequate floor load ratings, vibration sensitivity or dampening needs, awkward worker/equipment interfaces requiring special design considerations, etc.).
- Cabinets that will contain vacuum pumps should have mechanical ventilation to prevent build-up of exhaust and heat within the confined space. Tubing coming from equipment should be compatible with pump and chemical involved.

Best Practice

- Freezers or environmental chambers generate high heat loads and ventilation should be designed accordingly.
- Freezer farm rooms may require additional local cooling. Emergency power should be considered on select equipment to prevent loss of experiments and/or equipment damage.
- Experiments should be conducted near research equipment to shorten the length of tubing required.
- If experiment tubing is being connected directly to exhaust systems, the connection should be secured in a permanent manner even for temporary use (e.g., welded connection or clamp fitting).

Specialized Laboratories

Additional review and regulations may be required beyond general EH&S compliance. Deviations from regulatory compliance will need regulatory approval.

Laboratory Type	Group to Review	Codes, Standards, and Regulatory References
Biological	ESSR Biosafety Group	*Biosafety in Microbiological and Biomedical Laboratories (BMBL)* and *NIH Design Requirements Manual (DRM)*
Radiation/Radioactive Material	ESSR Radiation Safety Group	*Maryland Department of the Environment (MDE) and the Nuclear Regulatory Commission (NRC)*
Clean Room	ESSR Laboratory Safety Group	*International Organization for Standardization (ISO)*
Laser	ESSR ORS and Laser Safety Officer	*ANSI Z136.1*
Superconducting Magnet (NMR, MRI, etc.)	ESSR Laboratory Safety Group	American Conference of Governmental Industrial Hygienists (ACGIH) and Equipment Manufacture Requirements
Animal Care Facilities	University Department of Laboratory Animal Resources (DLAR)	University Department of Laboratory Animal Resources (DLAR)
Technology and Machinery	ESSR ORS	NFPA 652, OSHA – 29 CFR 1910 Subpart D
Teaching	ESSR OFM and ORS	

Deviations From Guide

Deviation from the requirements in this Guide must be documented and approved by the OFM and/or ESSR regulatory compliance lead (e.g., Chemical Hygiene Officer, Radiation Safety Officer, etc.) prior to incorporation into design plans. Certain regulatory requirements may preclude accepting deviations.

The project manager shall submit a deviation from the Guide request to ESSR with a Needs Assessment Checklist and a Risk Assessment Report. This request is to be sent to FireMarshalReview@umd.edu to track request and ensure correct personnel are incorporated in the review process.

Risk Assessment Report:

The primary way to justify the deviation is to complete a risk assessment. A risk assessment should include all details of the laboratory work planned in the space and the reasoning for why the requirement cannot be met. Depending upon the complexity of the risk assessment, the project may necessitate hiring a third-party consultant.

Once the project documents are reviewed and if deemed adequate, if approved, a signed *Approved Design Deviation Form* will be provided to the PM. ESSR will also maintain a copy and review periodically to ensure the conditions of approval have not changed. Deviations or changes in research or space use from the initial risk assessment will halt lab operations until proper safety measures or procedures are developed and introduced.