115000 LABORATORY EQUIPMENT

PART 1: GENERAL

1.01 RELATED SECTIONS

A. Section 013010 – Accessibility for People with Disabilities

B. Section 220500 – Plumbing Basic Materials and Methods

C. Section 224500 – Safety Showers and Eyewashes

D. Section 230540 – Laboratories

1.02 SCOPE

A. This Standard applies to the construction of new facilities and renovations to existing facilities in which chemical work is to be done at laboratory-scale. Consultants shall review project requirements with Facilities Engineering, Environmental Health and Safety (EH&S) and their Department/College Safety Officer early in the design process to ensure appropriate engineering and administrative controls are put in place as part of the design project. Deviations from this standard shall require approval from EH&S and Facilities Engineering.

B. Each laboratory, including research and teaching, shall have sinks, workstations, and fume hoods that are accessible to people with disabilities in accordance with Chapters 3 of the ICC/ANSI A117.1-2003 and 2010 ADA Standards for Accessible Design.

1.03 CODES AND STANDARDS

A. Designs shall comply with the requirements of the following codes and standards:

1. ANSI standards
2. Building Codes of New York State
3. NFPA standards
4. OSHA standards

B. Where codes and standards do not exist or are unclear, the design shall follow recommendations and guidelines set forth in the Cornell University Laboratory Safety Manual and Chemical Hygiene Plan, which can be found at [http://sp.ehs.cornell.edu/lab-research-safety/laboratory-safety-manual](http://sp.ehs.cornell.edu/lab-research-safety/laboratory-safety-manual) or other design guidelines established by the Department of Environmental Health and Safety (EH&S). Contact EH&S for more information at 607-255-8200.
C. Classification of hazardous materials shall be made in accordance with the definitions included in the Fire Code of New York State.

1.04 CHEMICAL STORAGE CABINETS, GENERAL

A. Chemical storage cabinets are used to store both solid and liquid chemicals such as flammables, acids, bases, toxics, and/or chemical wastes. These requirements apply to stand-alone cabinets, under counter cabinets, and fume hood base cabinets.

B. Chemical storage cabinets are required in the following situations:

1. When quantities exceed the maximum allowable limits as defined in the Fire Code of New York State;
2. When quantities of any one hazard class of liquid chemicals exceeds 10 gallons;
3. When 20-feet of separation distance between incompatible materials cannot be accommodated in the layout of the laboratory.

1.05 FLAMMABLE LIQUID STORAGE CABINETS

A. Generally, Cornell prefers that flammable liquid storage cabinets not be vented, however, it is imperative that the “bung caps” be provided in the bung holes (see NFPA 30).

B. If it is necessary to vent flammable liquid storage cabinets, then the following requirements must be met:

1. A professional engineer shall design the venting system.
2. Make up air must be introduced in the top vent of the cabinet. This make up air must come from a direct fresh air source and cannot come from the room where the storage cabinet is located.
3. Cabinets shall be vented from the bottom vent on the cabinet.
4. Cabinet vent ports must be equipped with flame arrestors.
5. Schedule 40 black steel pipe should be used for vent pipe.
6. Manifolding should be avoided, but if necessary, the duct material for the rest of the entire manifold exhaust system must be a minimum of 18 gauge steel sheet metal.
7. Venting of the cabinet must go directly outdoors.
8. The airflow rate for venting should be 25 scfm for cabinets equipped with 2-inch connections and 40 scfm for cabinets with 4-inch connections.
9. Mechanical exhaust ventilation should comply with NFPA 91.
10. Fan material must be resistant to the anticipated material or vapors. The fan blade must be non-static and all fan parts must be grounded and bonded across the ant-vibration flex connections. The fan motor shall be UL listed, Class I, Division I, totally enclosed and explosion-proof.
1.06 CORROSIVE STORAGE CABINETS

A. Corrosive storage cabinets can be designed to store either acids or bases (caustics).

B. Stand-alone corrosive storage cabinets are not required to be vented.

C. Fume hood base cabinets used for corrosive storage shall be vented.

D. Acid and base cabinets shall be vented using separate vent pipes.

E. Vent pipe shall be PVC or Poly-type tubing.

F. Corrosive storage cabinets shall be lined with a non-metallic liner such as polyethylene or polypropylene.

1.07 FUME HOODS

A. For the majority of laboratory projects on campus, air change rates in the lab environment typically inform the final system design. Fume hoods shall be of the Restricted Bypass Type suitable for 2-position or VAV airflow operation. They shall be designed to contain at an average face velocity of 100 FPM at an 18-inch sash opening height.

B. Generally, vertical rising sashes are preferred. The horizontal sliding or combination sashes may be used in the following situations, but only with final review and approval by EH&S and Facilities Engineering:
   1. Barrier Free (ADA) Fume Hoods
   2. When specifically requested by the Principal Investigator

C. Lining and workstation materials are to be suitable for the intended chemical use.

D. Fixed baffles are preferred over adjustable baffles.

E. Fume hoods shall have stops installed at an 18-inch sash height.

F. Auxiliary Air Fume Hoods shall not be used.

G. Fume hoods shall be specified to meet “As Manufactured” ANSI/ASHRAE 110 defined performance tests conducted on a representative hood that demonstrates adequate hood containment.

H. Acceptable Models, General Purpose:
   1. Bedcolab: Balanced Air, Variable Air Volume (VBV)
2. Jamestown: F-100 Series Isolator Gen-5  
3. Kewaunee: Supreme Air H05  
4. Labconco: Protector Premier  
5. Mott: Pro Restricted Bypass

1.08 ACCESSIBLE (BARRIER FREE) FUME HOODS

A. In addition to the requirements stated above, accessible Fume Hoods shall have the following features:

1. Airfoil by-pass with spill trough  
2. Manual Hydraulic Lift Base Stand, Labconco or approved equal.  
3. Lever handles on all plumbing service fittings

B. Acceptable Models, Barrier Free:

1. Bedcolab: Fully Accessible Fume Hood (VBH)  
2. Jamestown: F-100 Series Isolator Gen-5  
3. Labconco: Protector XL  
4. Mott: Fully Accessible Restricted By-Pass – Combination Sash

1.09 HIGH PERFORMANCE (LOW VELOCITY) FUME HOODS

A. For laboratories expected to have a high hood density or with small footprint where the air change rate due to fume hood exhaust will exceed the minimum laboratory air change rate established by EH&S, the use of a high performance fume hood can be considered. These fume hoods shall be designed to capture at a face velocity of 100 fpm and below, at an 18-inch sash opening height. Use of these hoods will be evaluated on a project-by-project basis, and shall be allowed only after approval from Facilities Engineering and EH&S.

B. The acceptable manufacturers listed below have all been vetted to have the following preferred design features:

1. Aerodynamic curve of the airfoil, sash and side walls that reduce eddy currents and encourage sweeping of air to the back of the hood.  
2. Baffles and passive opening at the top and bottom of the sash that aid in sweeping to the back and reduce eddy currents.

C. “Belly Bars” and multi-slotted airfoils shall not be installed as they increase ergonomic issues with the use of the fume hood.
D. Acceptable Models, High Performance:

1. Kewaunee: Supreme Air LV05
2. Jamestown: F-350 Series Isolator3
3. Labconco: Protector XStream
4. Mott: Model RFV2

1.10 FUME HOOD BASE CABINETS

A. Fume hood base cabinets can include storage for flammables, acids, bases, toxics, and chemical waste.

B. Fume hood base cabinets storing acids and bases shall be vented.

1. The preferred venting method is to run the vent pipe along the inside of the fume hood superstructure (hidden) and vent behind the top baffle.

2. Fume hood base cabinets can also be vented by running vent pipe through the fume hood countertop and behind the fume hood baffle. If this method of venting is used, then the vent pipe should be at least 6" above the fume hood countertop and chemically resistant sealant must be used around where the vent pipe comes out of the fume hood countertop.

C. Fume hood base cabinets designated to store flammables shall be equipped with a flame arrestor in bung openings, and shall not be vented.

1.11 VACUUM PUMP CABINETS

A. All vacuum pumps or vacuum pump cabinets shall be vented.

B. The preferred method of venting vacuum pump cabinets is to vent directly. However, it is acceptable to vent vacuum pump cabinets directly into the fume hood.

1.12 BIOSAFETY CABINETS, LAMINAR FLOW/CLEAN BENCHES

A. Biosafety cabinets (BSCs) are safety devices primarily used for containment when manipulating infectious and biohazardous materials, and to maintain aseptic conditions when using cell cultures.

B. Laminar flow/clean benches are product protection devices used for contamination control when manipulating materials requiring this level of control; including but not limited to pharmaceuticals, electronic equipment, and plants. They do not provide containment or user protection.

C. All BSC, Laminar Flow/Clean Bench purchases must first be approved by the University Biosafety Officer.
D. Class II, Type A2 Biosafety Cabinets are the most commonly encountered cabinets on campus and fulfill most research needs. Exhaust from these cabinets can be recirculated into the room, or linked via a thimble or canopy connection to direct air outside. These cabinets are for particle containment only and must not be used with flammable or volatile chemicals or radioactive materials. Type B2 cabinets are 100% exhaust (no recirculation in the work area) that provide biological and some chemical containment.

E. If possible, the BSC should be located in the laboratory away from air currents produced by ventilation inlets, opening/closing of the laboratory door(s), and away from areas of heavy traffic. An isolated tissue culture room is an ideal location.

F. All BSCs, Laminar Flow/Clean Benches must be certified by a contractor trained to National Sanitation Foundation Standard No. 49. BSC users must ensure that BSCs are certified on an annual basis. Contact the EH&S Biosafety Officer for a list of available contractors that provide this service.

1.13 COMPRESSED GAS CYLINDER RESTRAINTS

A. Compressed gas cylinders must be restrained. The use of fixed gas cylinder restraints is preferred over portable restraints (i.e., vice-style fastened to tables).

B. The use of chains to secure cylinders is preferred over the use of nylon (or other combustible) strapping.

1.14 GAS CABINETS

A. As a minimum, exhausted Gas Cabinets shall be provided for the following cylinder gases, when stored in any quantity within the lab:

1. Flammables – required as a performance based design alternative to allow flammable gas use in B Occupancies;
2. Toxics – required by the Mechanical Code of New York State;
4. Elsewhere as directed by a pre-operational safety review conducted by the Department Safety Officer, EH&S and Cornell Facilities Engineering.

1.15 GAS DETECTION EQUIPMENT

A. In areas where liquid nitrogen, helium, or other cryogens will be used in large quantities, the laboratory size and the ventilation rate shall be assessed for oxygen displacement. The use of local oxygen monitoring alarms is required in poorly ventilated areas, or in special cases like environmental chambers.
B. Consult with Cornell Facilities Engineering and EH&S to review minimum requirements regarding gas detection equipment for flammables, corrosives, toxics, highly toxics, and pyrophoric materials.

1.16 REFRIGERATORS

A. Newly constructed laboratories or retrofits intending to store flammable liquids in refrigerators shall include provisions for the purchase/use of refrigerators rated for the storage of flammable liquids as part of the design project.

1.17 LASERS

A. Contact EH&S early in the design process so the appropriate safety features may be incorporated into the project.

B. Laboratories using Class 3b and 4 lasers shall meet the requirements outlined in ANSI Standards Z136.1 and Z136.5, and the Cornell Laser Safety Manual, which can be found at [https://sp.ehs.cornell.edu/lab-research-safety/radiation/laser-safety/Pages/default.aspx](https://sp.ehs.cornell.edu/lab-research-safety/radiation/laser-safety/Pages/default.aspx). The Laser Safety Officer will review all Class 3b and 4 lab layouts, safety features, warning lights and signs, and safety interlock systems.

C. Homebuilt lasers, commercially available equipment that has been modified, and home built laser systems and equipment requires review and classification by the Laser Safety Officer. This equipment cannot be provided to, sold to, or operated by persons not involved with the modifications unless the equipment is certified to meet FDA regulations (21CFR1040 Subchapter J). Contact EH&S for additional information and assistance.

D. Laser beams may not leave the confines of the lab where the laser is located unless approved by the Laser Safety Officer.

1.18 RADIATION PRODUCING EQUIPMENT

A. Use of radiation producing equipment (x-ray, accelerator/implanter, transmission electron microscope, etc.) requires a permit from EH&S before being used. Contact EH&S for additional information and assistance. The current Radiation Safety Manual can be found at [https://sp.ehs.cornell.edu/lab-research-safety/radiation/radiation-safety-manual/Pages/default.aspx](https://sp.ehs.cornell.edu/lab-research-safety/radiation/radiation-safety-manual/Pages/default.aspx).

1.19 MAGNETS

A. Contact EH&S early in the design process so the appropriate safety features may be included. In general, room temperature and cryogenic/superconducting magnets need to be located so that the magnetic field does not exceed 5 gauss outside the confines of the laboratory (i.e., spaces on all six sides of the lab need to be assessed).
If fields exceed 5 gauss outside the laboratory, and shielding is not possible, the occupants of those spaces need to be informed and mutual agreement must be reached. The current Magnet Safety Manual can be found at https://sp.ehs.cornell.edu/lab-research-safety/radiation/magnetic-safety/Pages/default.aspx.

B. The 5 Gauss magnetic field boundary is to be identified. Contact EH&S to perform the survey and mark the boundary. Additional warning signs are required at the entrances to spaces where magnetic fields strengths can create projectile hazards should magnetic items enter that space. Sample signs are available from EH&S.

C. Cryogenically cooled magnet systems have the potential to quench causing the release of large amounts of nitrogen and/or helium gas. This can quickly create oxygen deficient areas which can be immediately dangerous to life and health. The venting of these gases and the control of potentially dangerous area shall be considered in the laboratory design.

D. Time varying magnetic fields can present different exposure hazards to humans and need to be evaluated on a case by case basis.

1.20 CHEMICAL WASTE STORAGE

A. Each space that will have hazardous chemical waste shall be provided with a cabinet designated specifically for this type of waste. EH&S, the Department/College Safety Manager, and Facilities Engineering shall be consulted on a project-by-project basis to discuss hazardous chemical storage needs.

1.21 CHEMICAL SECURITY CABINETS

A. In areas where controlled substances, radioactive stocks, highly toxic or highly valuable chemicals will be used and/or stored, the provisions for a locked storage cabinet should be given consideration.