Basic Laboratory Design for Biosafety Level 3

Containment facilities are described in the CDC/NIH publication Biosafety in Microbiological and Biomedical Laboratories (BMBL) and in the NIH Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules (NIH Guidelines).

**BSL-3 Laboratory Facilities**

The laboratory must be separated from areas that are open to unrestricted traffic flow within the building. Physical separation of the high containment laboratory from access corridors or other laboratories or activities may be provided by a double-door clothes change room (showers may be included), airlock, or other access facility which requires passage through two sets of doors before entering the laboratory.

Laboratory access is restricted. Laboratory doors must be self-closing and have locks in accordance with the institutional policies. Passage through two sets of doors is the basic requirement for entry into the laboratory from access corridors or other contiguous areas. A clothing change room (anteroom) may be included in the passageway between the two self-closing doors.

Laboratories must have a sink for hand washing. The sink must be hands-free or automatically operated and located near the exit door. If the laboratory is segregated into different laboratories, a sink must also be available for hand washing in each zone. Additional sinks may be required as determined by the risk assessment.

The laboratory must be designed so that it can be easily cleaned and decontaminated. Carpets and rugs are not permitted. Seams, floors, walls, and ceiling surfaces should be
sealed. Spaces around doors and ventilation openings should be capable of being sealed to facilitate space decontamination.

a. Floors must be slip resistant, impervious to liquids, and resistant to chemicals. Consideration should be given to the installation of seamless, sealed, resilient or poured floors, with integral cove bases.

b. Walls should be constructed to produce a sealed smooth finish that can be easily cleaned and decontaminated.

c. Ceilings should be constructed, sealed, and finished in the same general manner as walls.

Laboratory furniture must be capable of supporting anticipated loads and uses. Spaces between benches, cabinets, and equipment must be accessible for cleaning.

a. Bench tops must be impervious to water and resistant to heat, organic solvents, acids, alkalis, and other chemicals.

b. Chairs used in laboratory work must be covered with a non-porous material that can be easily cleaned and decontaminated.

All windows in the laboratory must be sealed closed.

BSCs must be installed so that fluctuations of the room air supply and exhaust do not interfere with proper operations. BSCs should be located away from doors, heavily traveled laboratory areas, and other possible airflow disruptions.

Vacuum lines must be protected with HEPA filters, or their equivalent. Filters must be replaced as needed. Liquid disinfectant traps may be required.

An eyewash station must be readily available in the laboratory.

A ducted air ventilation system is required. This system must provide sustained directional airflow by drawing air into the laboratory from ?clean? areas toward ?potentially contaminated? areas. The laboratory shall be designed such that under failure conditions the airflow will not be reversed.
a. Laboratory personnel must be able to verify directional airflow. A visual monitoring device, which confirms directional airflow, must be provided at the laboratory entry. Audible alarms should be considered to notify personnel of air flow disruption.

b. The laboratory exhaust air must not re-circulate to any other area of the building.

c. The laboratory building exhaust air should be dispersed away from occupied areas and from building air intake locations or the exhaust air must be HEPA filtered.

d. For research with mammalian-transmissible Highly Pathogenic Avian Influenza H5N1 virus, exhaust air must be HEPA filtered and there must be sealed ductwork from the containment barrier to the filter. In addition, the air handling system shall be designed such that under failure conditions, the airflow will not be reversed. Periodic verification with annual verification of the HEPA filters must be performed.

e. Backup power shall be available for critical controls and instrumentation necessary to maintain containment.

Selection of the class and type of biological safety cabinets (BSCs) should be based on a risk assessment specific to the research that is to be conducted. BSCs must be certified at least annually to assure correct performance. Supply air must be provided in such a manner that prevents positive pressurization of the cabinet. BSCs are designed to be connected to the laboratory exhaust system in one of two ways.

a. Thimble or canopy connection with partial recirculation to the laboratory space, e.g., for Class II type A2 BSCs

b. Hard ducted connection which directly exhausts HEPA filtered air to the outside of the building, e.g., for Class II type B2 or Class III BSCs

Equipment that may produce infectious aerosols must be contained in primary barrier devices that exhaust air through HEPA filtration or other equivalent technology before being discharged into the laboratory. The function of HEPA filtered equipment should be tested and certified at least annually, after moving, and after repair.
A method for decontaminating all laboratory wastes should be available in the facility, preferably within the laboratory (e.g., autoclave, chemical disinfection, or other validated decontamination method).

Facility design consideration should be given to means of decontaminating large pieces of equipment before removal from the laboratory.

Enhanced environmental and personal protection may be required by the agent summary statement, risk assessment, or applicable local, state, or federal regulations. These laboratory enhancements may include one or more of the following: an anteroom for clean storage of equipment and supplies with dress-in, shower-out capabilities; gas tight dampers to facilitate laboratory isolation; final HEPA filtration of the laboratory exhaust air; laboratory effluent decontamination; and advanced access control devices, such as biometrics.

The BSL-3 facility design, operational parameters, and procedures must be verified and documented prior to operation. Facilities must be re-verified and documented at least annually.

**Related Content/References**

- CDC/NIH Biosafety in Microbiological and Biomedical Laboratories
- NIH Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules