

The formulae  $\frac{\partial \rho U_i}{\partial t} + \frac{\partial (\rho U_i U_j)}{\partial x_j} = -\frac{\partial p}{\partial x_i} + \frac{\partial}{\partial x_j} \left( \mu \frac{\partial U_i}{\partial x_j} \right) + g_i (\rho - \rho_s)$  for building  $\frac{\partial}{\partial x_j} (\rho U_j \bar{U}_i) = -\frac{\partial p}{\partial x_i} + \frac{\partial}{\partial x_j} \left( \mu \frac{\partial U_i}{\partial x_j} - \rho \overline{u_i' u_j'} \right) + g_i (\rho - \rho_s)$  state of the art  $\frac{\partial}{\partial x_i} (\rho U_i \bar{H}) = \frac{\partial}{\partial x_i} \left( \lambda \frac{\partial \bar{H}}{\partial x_i} - \rho \overline{u_i' h'} \right)$  biomedical research facilities.

## Laboratory Door Design Considerations

One of the documents the Design Requirements Manual (DRM) references is the Biosafety in Microbiological and Biomedical Laboratories (BMBL) 5th Edition. The BMBL outlines many requirements for BSL-2 and BSL-3 labs, including the requirement for self-closing doors. This is reflected in Section 4.2.2 of the DRM, which requires that laboratory doors have closers. Although open doors are preferred by some lab users and may have operational advantages, the benefits are frequently outweighed by safety, biocontainment, and other design considerations.

### Differential Pressurization

Typical biomedical laboratory design relies on differential pressurization and the associated directional airflow to promote biocontainment. Directional airflow is achieved by the proper balance of the supply air against the exhaust and return air in the laboratory and is generally configured to uniformly move air from the cleanest/lowest hazard zones towards the dirtiest/highest hazard zones.

Differential pressure is controlled by HVAC settings and components such as sweeps and seals which adjust air leakage across the door. When the doors are cycled open and closed, differential pressure is momentarily lost until the HVAC system can build up the pressures across the door, a process called “recovery.” If doors are held open, differential pressures cannot develop, and the resulting airflow is ineffective for maintaining differential pressurization.

### Laboratory Door Requirements

**Fire Ratings.** Lab doors may be required to be fire-rated, based on NFPA 45 and the approved life safety documentation. Rated door assemblies are required to be UL listed and must be self-closing. The DRM prohibits hold-open devices on laboratory doors which inhibit their closing and latching in the event of a fire. This prohibition is one reason the DRM disallows pocket doors, accordion doors, and most sliding doors in laboratory applications (other concerns include durability, maintainability, cleanability, poor ability to develop differential pressures across them, and poor egress performance).

**Access Control.** Physical access control restricts access to approved personnel as required by both the BMBL and DRM. The intent of access control is to promote safety and deter human-induced hazards such as accidents, contamination, sabotage, and real or intellectual property theft. Coordinate door security devices and hardware with

the NIH Division of Physical Security Management (DPSM) per DRM Section 4.2.2.4.

DPSM can be reached at [DPSM-ServiceRequest@mail.nih.gov](mailto:DPSM-ServiceRequest@mail.nih.gov).

**Size.** The DRM requires that at least one door into every laboratory be at least 3’6” wide, which can be achieved with a single door or an active/inactive unequal leaf pair. Larger doors may be required to accommodate oversized equipment and to provide future flexibility, regardless of the requirements of the initial lab occupant.

**Swing and Latching.** DRM 4.2.2.3 requires doors to swing in the direction of exit travel. DRM 4.2.2.7.F requires constant-latching flush bolts on the inactive leaf of double door sets.

**Vision Panels.** DRM 4.2.2.8 requires vision panels in all lab doors. Vision panels are the topic of a News to Use article *Vision Panels in Laboratory Doors* dated December 2017, which can be accessed for additional information.

**Protection Plates.** DRM 4.2.1.6 requires stainless steel protection plates to protect the finish of doors in high traffic areas. Protection plates on fire-rated doors, however, must conform to the rating of the door assembly.

**Material and Finish.** Like other laboratory finishes, doors, frames, and hardware shall be durable, cleanable, nonporous, and resistant to chemicals.

Depending on the function and use of the lab, additional requirements may apply. Refer to specific DRM sections for animal facilities, aseptic production facilities, and other specialty applications.

### Additional Information

Biosafety in Microbiological and Biomedical Laboratories  
<https://www.cdc.gov/labs/BMBL.html>

Vision Panels in Laboratory Doors

[https://www.orf.od.nih.gov/TechnicalResources/Pages/DRM\\_News\\_to\\_Use.aspx](https://www.orf.od.nih.gov/TechnicalResources/Pages/DRM_News_to_Use.aspx)