

Specific Pathogen-Free Animal Research Facilities

Introduction

Specific pathogen-free (SPF) animal research facilities provide breeding, housing, and procedural space for animals free of a defined list of pathogens. SPF animals are distinct from gnotobiotic animals, which are completely germ free and require sterile facilities.

SPF facilities must be designed and operated to provide pathogen-free (though not sterile) environments to protect the health of the animals and the veracity of the research conducted within. An SPF facility can be as small as a microisolator housing a few animals, but a more typical facility is a dedicated suite consisting of one or more procedure rooms and holding rooms that is located within a larger general-purpose vivarium. Animals are either bred within the SPF facilities or introduced after quarantine and rigorous testing to confirm they are pathogen-free.

Strategies for Containment

Traditional biocontainment facilities maintain isolation with a tightly sealed perimeter envelope and mechanical systems that create cascading negative pressurization to prevent pathogens from exiting the containment barrier. SPF facilities utilize an analogous design strategy, but instead use cascading positive pressurization to prevent pathogens from entering the containment barrier. At the entrance to the SPF facility, there may be one anteroom or a series of anterooms serving as pressurized 'sinks' or 'bubbles' to prevent pathogens from entering or exiting the facility.

Similarly, SPF facility entry and exit protocols are designed to prevent pathogens from entering the facility. Sterilization is required for all personnel and all materials entering the facility. An entry sequence may include an anteroom, change area, PPE storage and disposal space, and autoclave, all appropriately pressurized with spaces becoming increasingly positive within the facility. Holding rooms are typically the most positively pressurized to maximize isolation.

The location of an SPF facility can enhance its operation and function. Location within a general-purpose vivarium provides a level of security, control, and proximity to support functions and personnel. Location in the interior of a building (i.e. not on a perimeter wall) will isolate the facility from wind, humidity, and temperature variations which reduces the burden on the mechanical system and segregate the facility from potential environmental contaminants.

Physical and Operational Considerations

As with any vivarium, an SPF facility should consider the physical, programmatic, and operational requirements of its

specialized function, all of which should be documented in the project Basis of Design. Considerations include:

- Access control, which should be tightly restricted.
- Travel paths of materials, animals, and personnel, which should be carefully planned to minimized exposure to contaminants, conflicts, and travel distances.
- The entry sequence for personnel, which includes gowning and PPE that is sterile and appropriate for working with the animal species in the facility. Requirements may include lockers, changing rooms, and an air or water shower.
- The entry sequence for materials, which may include an autoclave, fumigation chambers, UV chambers, and other methods of sterilization.
- The number, size, and adjacencies of rooms, which may include one or more holding rooms, procedure rooms, storage areas, and rooms for support functions and equipment.
- Husbandry requirements, including noise, vibration, temperature, humidity, and lighting for all species under consideration.
- Decontamination or sterilization needs for individual rooms or the entire facility. Methods, agents, procedures, and impact on continuous operations must all be considered.
- The design of walls and ceilings, which must withstand the pressure differential, prevent pathogen transmission, facilitate decontamination, and resist degradation from exposure to chemical disinfectants and other cleaning materials and methods.
- The design of floors, which must be monolithic, slip resistant, and resistant to chemical disinfectants. Floor drains, if required and used, should be capped and include deep seal traps filled with chemical disinfectant.

Summary

SPF animals are valuable research models which require specifically designed facilities. These facilities should provide environments which protect the health and pathogen-free status of the animals and the integrity of the research conducted within.

Additional Reading

Guide for the Care and Use of Laboratory Animals, Eighth Edition (2011), The National Academic Press
Biosafety in Microbiological and Biomedical Laboratories (BMBL) 6th Edition, <https://www.cdc.gov/labs/BMBL.html>

