

## Lighting Design Considerations for Animal Research Facilities

### Introduction

Proper lighting is critical in animal research facilities (ARFs) to ensure animal health and the reliability of the research test results. Lighting levels and controls depend on the usage of the space and on the type of species occupying the space. As with all aspects of ARF design, veterinarians and animal care staff must be consulted. This article reviews recognized good design practices.

### Key Points

In ARFs, lighting must be carefully controlled to maintain consistent light cycles (photoperiods). Artificial light can significantly disrupt the natural circadian rhythms of animals, leading to hormonal imbalances and disrupt their feeding, mating, nourishment, and sleep patterns.<sup>1</sup> Tailored lighting strategies based on animals' natural habitats and behaviors are therefore necessary for optimal welfare. In addition, the intensity and color spectrum of light can significantly impact animal behavior; for instance, using warm-toned lights during the resting phase can promote relaxation, while cooler tones may be used during active periods. Improper nighttime lighting also contributes to cancer in animals: exposure to artificial light at night has been linked to increased tumor formation.<sup>2</sup> See "Further Reading" at the end of this article for more on the effects of light on animals.

### Important Factors: Design for Artificial Lighting & Controls

- Light cycle:** Maintain a consistent light/dark cycle based on the animal's natural photoperiod.
- Light intensity:** Adjust light intensity depending on the activity level required (e.g., lower intensity during resting periods).
- Light color:** Select an appropriate color temperature based on the animal's visual needs and desired behavioral response. Choose lighting with warm colors and minimize the percentage of blue light (which has been linked to negative effects on animals<sup>3</sup>) emitted. Using warm-colored bulbs and reducing blue light emission will help mitigate negative impacts and preserve natural behavioral responses.
- Lighting uniformity:** Lighting for vertically stacked cages or aquatics tanks in racks should be uniform for all enclosures.
- Light source selection:** Light is an environmental factor that is extrinsic to animals and exerts a profound influence on the regulation of neurohormonal and neurobehavioral systems of animals.<sup>3</sup> LED lighting is a popular choice due to its energy efficiency and the ability to adjust the intensity as needed.
- Control coordination:** An LED driver must be coordinated with specified controls to avoid lamp flickers in an ARF. LED drivers in fixtures and controls such as occupancy sensors should be calibrated to avoid lamp flickering.
- Using amber or red lights:** Long-wavelength lights such as amber and red lamps may be used as they provide sufficient lighting for human visibility but are less noticeable to most animals.
- Environmentally friendly certification:** Lighting equipment for animal research labs shall comply with the animal design requirements. The "Underwriters Laboratories (UL) Listed" certification for lighting fixtures identifies environmentally friendly lighting solutions that have low color temperature and help reduce light pollution.

- Smart control technology:** The advancements in smart control technology simplify the management of light intensity, while adaptive controls ensure the preservation of natural darkness during nighttime. Investing in smart controls and LED technology allows a user to conveniently regulate lights, establish timers or dimmers, activate motion sensor lighting, and even adjust the emitted light's color.
- Lighting control system:** APFs should have a programmable lighting control system in facilities using either a BAS (Building Automation System) or a standalone system. This system should allow for the control and adjustment of lighting capabilities.
- Occupancy sensors:** Occupancy sensors in facilities shall have no ultrasonic sound emissions, as these may cause inadvertent distress in animals.
- Power levels:** In an animal research/surgery lab, 50% of lighting fixtures should be set to normal power while the remaining fixtures should be set to emergency power using a single toggle switch.

### Schedules

Maintaining proper written and tracked lighting schedules in ARFs helps ensure that the lighting is following the predetermined schedule in each of the lab's animal research rooms. Best practices typically include using light sensors to ensure that the lights are turned 'on' or 'off' according to lighting schedules and providing 24/7 monitoring of the lights inside an ARF. Issue real-time alerts as necessary so that personnel can identify whether any experiments are at risk and take corrective action. Light sensors can also be remotely calibrated to conform to different lighting systems and intensities and offer various customization options to meet the lab's research needs.

### Conclusion

Lighting is important design aspect in animal labs and can impact the quality of scientific research. Understanding the impacts of light intensity, measurements, and calibrations allows designers to take corrective actions to minimize light intensity and variability, thereby improving animal welfare and the accuracy of research experiments.

### References and Further Reading

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