

Red LED Light use within a Vivarium

A Kenall Informational Bulletin

The Competitive Edge Series: Issue #1

Sealed Enclosure

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Research facilities commonly use rats for study, and therefore have to address the issue of proper lighting for these nocturnal animals. Studies

Vivarium:
A cleanroom laboratory designed for keeping animals under seminatural conditions for study or observations.

indicate that the timing and duration of light and dark cycles (called a photoperiod) influences the body weight and food intake of laboratory animals. It also can induce a shift in the circadian rhythms of blood pressure, heart rate and activity. One

study reported, "Light is the most important environmental signal regulating the temporal pattern of animal behavior and physiology, regulating circadian rhythms and stimulating and synchronizing breeding cycles." 1

Preserving Circadian Rhythms for Better Research Results

Restricting the use of white light in vivariums allows research technicians to continue work, while at the same time preserving the animals' natural circadian rhythms. This reduces stress and allows the animals to behave more naturally, which ultimately produces more reliable research results. Additionally, this study indicates that using programmed dimming that mimics dawn and dusk is preferable for researchers interested in the changes in animal behavior when animals are primarily active in the twilight.

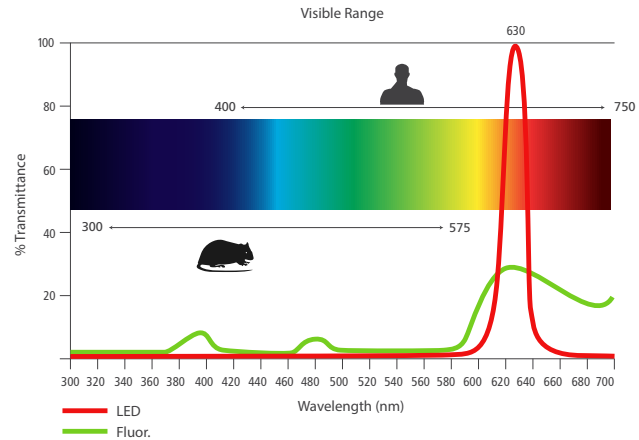
The Downside of Filters

Since red light is invisible to rats (and to some other research animals), it is used at times when white light would disrupt activity cycles. Historically, the industry has used filters, such as the RC-3 from Solar Graphics, in cleanroom fixtures to produce the desired color. The use of white light and red light is then automated to assure conformity to the schedule appropriate for that animal. If a fixture must generate both white and red light, typically one lamp would be fitted with a red-filtered lamp sleeve and a separate circuit.

However, filters only reduce but do not eliminate the visible light. Vivarium red filters deliver about 6% total light with 1% of that generated in the subject's visible range. From the subject's perspective, they would see the same light now at 10 percent perceived intensity (with some assumptions being made). Over time, the filter's effectiveness continues to degrade, allowing even more visible light, which further erodes the effectiveness of the vivarium.

The First True Red LED Light

Red LEDs made with AlInGaP die chemistry have advantages that filters cannot provide. The use of 630nm red LEDs offers pure, consistent and controllable red light intensity over time. They do not degrade in purity, even when light output has degraded.



Unfiltered LED light also allows for higher luminous flux and consequently higher illuminance levels on work surfaces, resulting in improved visibility and working conditions for research personnel.

Without a filter effectively blocking 99% of a traditional light source's output, a red LED solution also provides an unmatched reduction of energy consumption for photo-sensitive applications like Vivariums. This is true not only on a per-unit-basis but in the entirety of the room layout, as fewer luminaires would be required to achieve target illumination levels. Combined with lower lighting maintenance costs, the operational cost of Vivarium lighting can be substantially reduced by utilizing lighting with unfiltered red (AlInGaP) LED technology.

Recommendations:

- Lighting needs to be controlled by an automatic time system.
- Light levels need to be limited to prevent eye damage to the rodents according to the following chart:
- A feedback system measuring light levels needs to be used and data is to be recorded for verification.
- Interruptions in the dark cycle must be controlled to short durations using local override control and be carried out under low levels of 630nm red LED light.

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- Biosafety areas must use cleanroom fixtures rated IP-65 and cleanroom class 100.
- Stainless steel surfaces are required where cleaning processes use VHP, Quaternary Ammonium or other caustic sanitizers.
- One-piece overlapping doorframes with beveled edges for a sure seal and sanitization.
- BSL-3 and 4 fixtures and are recommended to be surface mounted with sealed wireways.

	Range of illumination	
Photoperiod	High	Low
White Light Cycle(Day)	25-35 fc	1 fc
Albino rodents	>10 fc	1 fc
Red Light (override)	10-15 fc	0.1 fc
Dark Cycle	>0.01 fc	0
Cleaning and Maintenance	80 fc	

Definitions: Diurnal= observes a 24 hour cycle. Most mammals are Diurnal.

Nocturnal= Active at night

Circadian Rhythm= A daily rhythmic activity cycle, based on 24-hour intervals, that is exhibited by many organisms

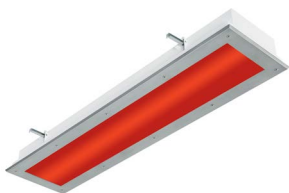
Purity= the quantification of the monochromaticity of a given light sample.

Sources:

1 (Cited from: "Noise and Light in the Vivarium" <http://www.alnmag.com/articles/2010/01/noise-and-light-vivarium>)

ARSAC Design Standards for Small Animals (Rodents) Vivarium

NIH Guide for the Care and Use of Laboratory Animals



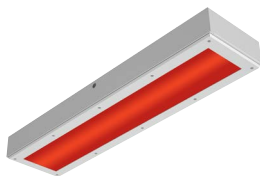
1'x4' Overlapping Doorframe-
All Red or Red & White LED
CSEDO14-Vivarium



2'x2' Overlapping Doorframe-
All Red or Red & White LED
CSEDO22-Vivarium



2'x4' Overlapping Doorframe-
All Red or Red & White LED
CSEDO24-Vivarium



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