LIGHT EXPOSURE FOR ARTIFACTS ON EXHIBITION

Light is a common cause of irreversible damage to collections. Cumulative over time, visible and ultraviolet (UV) light can cause not only fading, but weakening, discoloration, yellowing and embrittlement of paper, textile, leather, and adhesives. It also accelerates chemical reactions that cause deterioration. Any change in materials caused by light can be mitigated by controlling the intensity of light and amount of UV light artifacts are exposed to. When artifacts are placed on exhibition, steps should be taken to ensure that light exposure is controlled, monitored, and recorded.

Visible light is measured in terms of *lux*. A *lux* is equal to 1 light unit (*lumen*) per square meter. The exposure of an artifact to light is typically stated in terms of lux hours:

Illumination Level (lux) x *Number of hours/day* x *Days = lux hours*

Following this formula, the exposure of an artifact can be calculated. If an exhibit case is typically dark with occasional illumination, the exposure can be calculated according to the following example:

5 minutes (0.083 h.) of illumination of 50 lux (5 footcandles) per 10 times in one day is equal to 41.5 lux hours:

50 lux x (0.083 h. x 10) x 1 day = 41.5 lux/hours

One footcandle (ft-c) equals approximately 11 lux.

ILLUMINATION ON EXHIBIT

The exposure to light of an artifact planned for exhibit should be quantified.

- The exhibit case and illumination should be designed to eliminate UV light as much as possible. UV light can be eliminated from artificial light sources, since it is not visible. UV light from daylight should be minimized by positioning of the case and filtering. The standard limit of UV light of *75 microwatts per lumen* (µW/lm) should be considered the maximum allowable.

- The standard recommendation for illuminance of sensitive objects is *50 lux-100 lux.* The exhibit case design should be based on this range. The actual illuminance within the case should be measured to ensure that the exposure limits are being followed.

- The exhibit case should take advantage of strategies to minimize light exposure such as passive systems to darken the case when not being viewed. If the case is not

264 S. 23rd STREET, PHILADELPHIA, PENNSYLVANIA 19103, *t* 215.545.0613, *f* 215.735.9313, *www.*CCAHA.ORG

continually illuminated, the duration of light exposure in the case should be monitored or estimated in order to plan the total exposure of the artifact.

- Transmitted light, such as exposure through a light box, should not be used.

MONITORING ROUTINE

A schedule of regular illumination monitoring within the exhibit case should be established and taken into consideration when planning for temporary exhibitions.

- Dataloggers are available to monitor illuminance, temperature, and humidity. If a datalogger is not used, the illuminance within the case should be checked using a light meter (e.g. *Elsec 7650 Handheld light Monitor*) on a routine basis. The UV exposure within the case should be tested annually.

- Blue wool standard test cards should also be used within the exhibit case as a monitor of the actual fading.

- The artifact should be tested for fading with a spectrophometer on a routine basis depending on the duration of annual exhibition.

- A permanent record of light exposure for the artifact should be established. This record should be updated for each exhibition of the artifact in order to monitor the lifetime exposure of the artifact.

RECCOMMENDED LIGHT LEVELS FOR SENSITIVE ARTIFACTS

- **Very Light Sensitive Objects (textiles, watercolors, photographs and papers)[1]***

Total exposure per year – 5.000 footcandle/hours (50.000 lux/hours).

Rest for 3 years minimum between display cycles.

Any combination of light level and intensity which gives the maximum exposure or less may be used.

For example: 5 ft-c x 10 hr/day x 100 days = 5.000 ft-c/hrs
10 ft-c x 10 hr/day x 50 days = 9.000 ft-c/hrs

Ideal UV exposure 0-10 µW/lm with a maximum of 75 µW/lm.

- **Moderate Light Sensitive Objects (paintings, wood, leather)***

*These standards assume that all other environmental conditions for mixed collections meet conservation standards: all UV light and IR radiation has been filtered out; RH at 40-60%; T at 16 - 25°C; air contaminants filtered out. Sealed frame packages for loaned items recommended to minimize exposure to high or fluctuating RH and T in transit.

264 S. 23rd STREET, PHILADELPHIA, PENNSYLVANIA 19103, *t* 215.545.0613, *f* 215.735.9313, *www.*CCAHA.ORG

Total exposure per year – 10.000 footcandle/hours (100.000 lux/hours).

Rest for 2 years minimum between display cycles.

Any combination of light level and intensity which gives the maximum exposure or less may be used.

For example: 5 ft-c x 10 hr/day x 200 days = 10.000 ft-c/hrs
10 ft-c x 10 hr/day x 100 days = 10.000 ft-c/hrs

Ideal UV exposure 0-10 µW/lm with a maximum of 75 µW/lm.

- **Less Light Sensitive Objects (metal, ceramics, stones, glass)***

Total exposure per year – 30.000 footcandle/hours (300.000 lux/hours).

Rest for 1 year minimum between display cycles.

Any combination of light level and intensity which gives the maximum exposure or less may be used.

For example: 10 ft-c x 10 hr/day x 300 days = 10.000 ft-c/hrs

Ideal UV exposure 0-10 µW/lm with a maximum of 75 µW/lm.

USEFUL RESOURCES

ASHRAE Handbook – HVAC Applications, "Museums, Galleries, Archives and Libraries (MGAL), Chapter 24", 2019.
https://www.ashrae.org/technical-resources/ashrae-handbook

Ballard, Mary W., Bolin Courtney, Ohno Yoshi, McClean Taylor, Lena Nick. "LED Lighting in Museums: Conservation and Colors of Textiles", 2015.
https://repository.si.edu/bitstream/handle/10088/31347/mci38560.pdf?sequence=1&isAllowed=y

Canadian Conservation Institute. "Ultraviolet Filters." Canadian Conservation Institute (CCI) Notes 2/1. Ottawa, ON: Minister of Public Works and Government Services, 1994.
https://www.canada.ca/en/conservation-institute/services/conservation-preservation-publications/canadian-conservation-institute-notes/ultraviolet-filters.html

Del Hoyo-Melendez, Julio M.; Mecklenburg, Marion F.; Teresa Domenech-Carbo, Maria; "Determination of the Annual Light Exposure Received by Two-Dimensional Museum Objects Displayed on Vertical Surfaces using Photometric Measurements", Studies in Conservation, Volume 56, Number 1, p.31-40 (2011)
https://www.iiconservation.org/node/2910

Maekawa Shin, Beltran Vincent L., Henry Michael C., "Environmental Management for Collections", Getty Conservation Institute Publications, 2015.
https://books.google.com/books?id=r4c0DwAAQBAJ&pg=PR2&lpg=PR2&dq=light+monitoring+vincent+beltran&source=bl&ots=EpGEOBp7Ud&sig=ACfU3U2Yx4dAfwzMrEmF5xqxKE0ucmG_Mg&hl=en&sa=X&ved=2ahUKEwjH9_zfuqvmAhWjVt8KHZ1ZAuwQ6AEwBXoECAoQAQ#v=onepage&q=light%20monitoring%20vincent%20beltran&f=false

Merritt Jane, Reilly Julie A., "Preventive Conservation for Historic House Museums", 2010.
https://books.google.com/books?id=sTaZ69GEOkIC&printsec=frontcover&dq=Preventive+Conservation+for+Historic+House+Museums&hl=en&newbks=1&newbks_redir=0&sa=X&ved=2ahUKEwj_2Y_vu6vmAhVSmuAKHZ3dBaoQ6AEwAHoECAMQAg#v=onepage&q=Preventive%20Conservation%20for%20Historic%20House%20Museums&f=false

Museum Galleries Scotland. "Advice Sheet: Monitoring Light and UV Radiation in Museums." 2003.
https://www.museumsgalleriesscotland.org.uk/advice/collections/monitoring-light-and-uv-radiation/

Sackler Gallery & Freer Gallery of Art. "Light Duration Guidelines for Exhibited Works of Art." Smithsonian Institution. 2011.
http://www.connectingtocollections.org/wp-content/uploads/2011/08/hbcu-light-levels-for-storage-and-exhibition.original1.pdf

Texas Historical Commission. "Recommended Light Levels for Museum Collections." 2013.
https://www.thc.texas.gov/public/upload/publications/Light%20Level%20Recommendations%202013.pdf

Weintraub, Steven. "Comments regarding LEDs and the risk to light sensitive materials." 2010.
http://www.conservation-us.org/docs/default-source/resource-guides/download-comments-regarding-leds-and-risks-to-light-sensitive-materials-.pdf?sfvrsn=1