



## LIGHT EXPOSURE FOR ARTIFACTS ON EXHIBITION

Light can cause damage to collections. The amount of damage is determined by the intensity and type of light, the time of exposure, and the natural resistance of the object's components. Light damage is not only limited to fading: overexposure can also cause weakening, discoloration, yellowing and embrittlement. Damage caused by light exposure is both **cumulative** and **irreversible**.

Light damage can be mitigated by controlling the amount of total light exposure over time. When artifacts are placed on exhibition, steps should be taken to ensure that the light exposure is controlled, monitored, and recorded. Facsimiles may also be used to avoid overexposure of the original artifact. Objects that are not on exhibit should be kept in darkness.

### ULTRAVIOLET RADIATION

Ultraviolet (UV) radiation is an invisible component of many light sources including sunlight, fluorescent lights, and traditional tungsten light bulbs. It contains more energy and is therefore more damaging than visible light. Human eyes cannot detect UV, so filtering UV will not affect the visual experience except for on certain very specific materials such as Day-Glo paints. Many modern white papers also contain optical brighteners, which will make paper appear slightly whiter when UV is present, but this is not a significant difference.

### MEASURING LIGHT AND UV

Visible light and UV can be measured with a handheld lightmeter or datalogger. Less accurate light measurements can be taken with a smartphone app. Light readings should be taken slightly in front of the actual object, carefully following the manufacturer's directions. Visible light is measured in *lux* or *footcandles*. One footcandle (fc) is equivalent to approximately 11 lux.

Ultraviolet is measured in microwatts per lumen ( $\mu\text{W}/\text{lm}$ ), which describes the fraction of ultraviolet radiation in visible light. Because it is a ratio, the total UV will increase as the light levels increase, even as the ratio remains constant.

The exposure of an artifact to light is a product of illumination level and time:

$$\text{Light level (lux)} \times \text{Time (hours)} = \text{Exposure (lux hours)}$$

Understanding this formula, it is clear that exhibiting an object for 1 hour at 100,000 lux (direct sunlight) is equivalent to exhibiting the object for 200 hours at 50 lux (museum lighting). Both of these hypothetical exhibits may cause some light damage, but the museum lighting levels allow for a far longer exhibition before damage occurs:

Light level	X	Time	=	Exposure
100,000 lux	X	1 hour	=	100,000 lux hours
50 lux	X	2000 hours	=	100,000 lux hours

## ILLUMINATION ON EXHIBIT

An artifact's exposure to light can be predicted based on the light levels and the length of the exhibit. Exposure can be controlled by limiting the light level, the time exposed, or a combination of the two factors.

- The standard recommendation for illuminance of sensitive objects is 50-100 lux. The exhibit 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.
- Artifacts in an exhibit should be classified according to their light sensitivity, and the exhibit lighting and duration should reflect this (see following chart).
- The exhibit case should take advantage of strategies to minimize light exposure such as keeping the exhibit space in darkness when the exhibit is closed to the public. Motion sensors or curtains can also be used to ensure the object is only illuminated when a visitor is present.
- The exhibit should be designed to eliminate as much UV as possible. UV light can be avoided by selecting light sources that do not emit UV or adding UV-filters to existing light sources. Framed objects and display cases should use UV-filtering acrylic.
- Daylight should be reduced by positioning of the case and filtering. Window films can either reduce total light (neutral density filters) or specifically reduce UV radiation. Blackout shades or shutters can eliminate daylight during closing hours. Remember that UV-filtering films only have a lifetime of about 10 years, and will need to be periodically checked and replaced when they are no longer effective.
- The standard limit of UV radiation of 75 microwatts per lumen ( $\mu\text{W}/\text{lm}$ ) should be considered the maximum allowable, but 0-10 microwatts per lumen is easily achievable with today's technology.

## MONITORING ROUTINE

A schedule of regular illumination monitoring should be established for all exhibits.

- Dataloggers can be placed to monitor illuminance, temperature, and humidity over time. If a datalogger is not used, the illuminance 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 can be used within the exhibit as a monitor of the actual fading, however, the most sensitive blue wool swatch is more lightfast than many common colorants, so it should not be used as the only indicator.
- Artifacts of high value or suspected sensitivity can be tested for fading with a spectrophotometer on a routine basis.
- A permanent record of light exposure for each 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.

## CONSERVATIVE LIGHT LEVELS FOR SENSITIVE ARTIFACTS

Category	Visible Light	Ultraviolet Light
<b>Sensitive Collections:</b> Works of art on paper, photographs, textiles	50 lux maximum Restrict exhibition to three months every five years	Ideal: 0-10 microwatts per lumen  Maximum: 75 microwatts per lumen
<b>Less Sensitive collections:</b> Oil paintings, wood, leather	150 lux maximum Restrict exhibition to three months every two years	Same
<b>Least sensitive collections:</b> Metal, ceramics, stones, glass	300 lux Continuous exhibition is acceptable for most objects.	Same

If a higher light level is used in an exhibition, the exhibit time should then be reduced to achieve an equivalent total exposure.

Within each category, specific objects will be more or less light sensitive. Exhibition guidelines for a particular object could be adjusted if the components and exhibition history are well understood, however, these categories should be used as a starting point.

## USEFUL RESOURCES

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