



Preservation Tips

Managing Exhibit Light

Light is damaging to museum and archival collections, but is necessary in a successful exhibit. Developing a light management program helps historical institutions find a balance between collection care and exhibit needs.

Benefits of managing exhibit light:

- Damage prevention
- Helps determine exhibit turnover schedules

Tools needed:

- UV light meter
- Visible light meter
- Light worksheet
- Calculator

Light is divided into many different types, but for exhibit we only need to look at ultraviolet (UV) light and visible light. UV light causes fading, yellowing, cracking and embrittlement. Since UV light is not visible, it is not needed to view an exhibit and so we are able to completely block it with no impact to the visitor experience. Eliminating UV light is achieved through using lights that produce no UV light and blocking windows either completely or with UV filters. To confirm the absence of UV light a UV light meter is utilized to take a base reading of the room. A reading below 1 microwatt per lumen ($\mu\text{W}/\text{lm}$) indicates the successful blocking of UV light.

Visible light causes fading of inks and dyes, but a certain amount of visible light is needed to view exhibits. Since any visible light will, over time, fade most archival, textile and dyed objects we must ensure that the amount of light received by an object is less than the amount of light which will fade the object. Despite the common misconception that we remove objects from exhibit to “rest”, the damage caused by light exposure is cumulative. An artifact on exhibit for 6 months which rests for 6 months before being exhibited for 6 more months will experience the same damage as if it remained on continuous exhibit for 12 straight months in the same conditions.

Measuring exhibit light levels:

When an exhibit is installed a light reading should be taken on each object. The reading should be taken with a calibrated light meter (available from most archive and museum supply companies). Readings should be taken in a “real life” scenario, meaning they should be taken with exhibit lights at the levels of the open exhibit. If there is sunlight in the gallery, levels should be taken at the high point of exposure (e.g. in an east facing exhibit the readings should be taken in the morning), the meter should be held just above the artifact at the same angle as the artifact and whenever possible cases should be closed.



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Determining material type:

Certain materials like watercolors, silks and ball point ink are very sensitive to visible light and will fade quickly. Other materials like pencil, oil paint and black and white photographs are more lightfast and will maintain their color longer. It is important that the material make-up of an object is determined before it goes on exhibit. Some objects may be made of multiple material types, for example a metal helmet might have leather straps and textile inserts. When multiple materials are present the most light sensitive material should be used to determine exhibit light allowance. Once the material is identified, the reviewer can determine the light category of the item. Below is a chart outlining the blue wool category for common museum and archival materials.

Category 1	Category 2	Category 3	Category 4
Watercolor Iron gall inks, Construction paper, India Ink	Ball point ink, Silk, Color photos with "color" in the name, Felt tip ink	Textiles	Tintype, Leather, Color photographs with "chrome" in the name
Category 5	Category 6	Category 7	Category 8
Printer inks	Wood (no matter the finish) Acrylic paints	Silver gelatin black and white photos, Lithographs,	Oil paintings, Metal, Pencil

Chart 1



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Blue Wool categories:

The International Organization Standard (ISO) established a standard to determine the color fastness of different materials. The standard is based on the known fade rates of eight different swatches of blue wool. This standard, called the Blue Wool standard, has been adopted by museum professionals to aid in the determination of fade in museum and archival items.

Historically, museums have placed blue wool cards, a card with a swatch of each blue wool type, in exhibit cases to aid in the tracking of artifact fade. While this procedure does help determine if a material has faded, the determination can only be made after the artifact has faded and thus been irreparably damaged. Instead of using the cards to determine fade after the fact, we use the information provided by the standard to predict fade and reduce damage to artifacts. The below process is one way to utilize this information to ensure the safe exhibit of artifacts.

Each blue wool category has a known amount of light it can receive before a “just noticeable fade” occurs. The table below gives the exposure dosage until “a just noticeable fade” is reached for each category of material. The amount of fade will change in the presence of UV light so the chart is divided to account for the presence or absence of UV light. The ISO standard is written using the lux scale and is the most useful in making light exposure calculations. **This chart is in megalux which means you must multiply by 1,000,000 to convert to lux.**

	ISO #1	ISO #2	ISO #3	ISO #4	ISO #5	ISO #6	ISO #7	ISO #8
with no UV	0.3	10	3	10	30	100	30	1000
with UV	0.22	.6	1.5	3.5	8	20	50	120
	High Sensitivity			Medium Sensitivity			Low Sensitivity	

Chart 2

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Determining exposure:

Once the readings are taken and the fade categories are determined, the light exposure during exhibit can be calculated. This is done by calculating the total number of hours your material will be exposed to light while on exhibit. Once you have determined the exhibit length you will determine your total exposure by multiplying the exhibit length by your light reading. Below are examples for three objects, a metal helmet with leather straps and textile inserts, a watercolor and a Kodachrome photograph. In these examples your exhibit is open eight hours a day six days a week (lights are off when the exhibit is closed), you plan on having the exhibit open for one year and all UV light is blocked.

8 hours x 6 days=48 hours/week
48 hours/week x 52 weeks =2,496 total hours on exhibit

Metal helmet light reading is 150 lux and is in light exposure category #3 giving an allowance of 3,000,000 lux/hours (from chart 2)
 $150 \times 2496 = 374,400$ lux/hours
 $3,000,000 - 374,400 = 2,625,600$ lux/hours remaining

Watercolor light reading was 130 lux and is in light exposure category #1 giving an allowance of 300,000 lux/hours
 $130 \times 2496 = 324,480$ lux/hours
 $300,000 - 324,480 = -24,480$ lux/hours remaining

Kodachrome light reading was 90 lux and is in light exposure category #4 giving an allowance of 10,000,000 lux/hours
 $90 \times 2496 = 224,640$ lux/hours
 $10,000,000 - 224,640 = 9,775,360$ lux/hours over exposed

Therefore your helmet and your Kodachrome photograph will both see no damage while on this hypothetical exhibit, but your watercolor will see a “just noticeable fade” before the exhibit is over.

You have several options to eliminate the potential risk to the watercolor. The exhibit length for that item can be shortened, either through switching the watercolor for another artifact or by switching for a reproduction. You can attempt to adjust the amount of light hitting the objects by readjusting light angles or by lowering light levels. Or you can move the object to a darker section of the exhibit. These adjustments should be made as soon as possible to avoid extended exposure to the high light level.

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Documentation of light exposure:

As stated above, light damage is cumulative. It is therefore important to maintain a log of the exposure each item receives while on exhibit. This log should become part of the object record and should be consulted before any additional exhibit. Below is an example of a light exposure worksheet.

Item Number: _____

Total lux hours till Fade: _____

Exhibit #1: _____

Dates: _____

Exposure on Exhibit: _____

Remaining lux hours till fade: _____

Exhibit #2: _____

Dates: _____

Exposure on Exhibit: _____

Remaining lux hours till fade: _____

Exhibit #3: _____

Dates: _____

Exposure on Exhibit: _____

Remaining lux hours till fade: _____

Exhibit #4: _____

Dates: _____

Exposure on Exhibit: _____

Remaining lux hours till fade: _____

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Each item receives its own exposure sheet which is filled out at the conclusion of each exhibit. The “total lux hours till fade” indicates the light category tfor the item and the “exposure on exhibit” indicates how much exposure an item has received during a specific exhibit. The “remaining lux hours till fade” indicates how much exposure allowance remains for future exhibits. After an exhibit the form for your helmet would look like this:

Item Number: Helmet

Total lux hours till Fade: 3,000,000

Exhibit #1: Pants exhibit

Dates: 21 April 2001 - 21 April 2002

Exposure on Exhibit: 374,400

Remaining lux hours till fade: 2,625,600

Exhibit #2: _____

Dates: _____

Exposure on Exhibit: _____

Remaining lux hours till fade: _____

Exhibit #3: _____

Dates: _____

Exposure on Exhibit: _____

Remaining lux hours till fade: _____

Exhibit #4: _____

Dates: _____

Exposure on Exhibit: _____

Remaining lux hours till fade: _____

If the item goes on exhibit again the 2,625,600 would be the starting allowance and the exposure from the second exhibit would be subtracted from that.

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