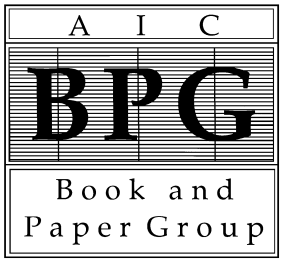

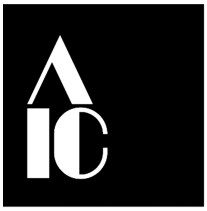

american
institute for
conservation

Preserving Cultural Heritage

Article: Developing a Comprehensive Approach to Light Exposure at the US Army Heritage and Education Center
Author: Jordan Ferraro
Source: Book and Paper Group Annual 38, 2019.
Pages: 9 - 14
Editors: Justin Johnson, Managing Editor & Kimberly Kwan, Assistant Editor
Editorial Office: bpgannual@gmail.com
ISSN: 0887-8978

The *Book and Paper Group Annual* is published once each year in print format by the Book and Paper Group (BPG), a specialty group of the American Institute for Conservation (AIC).

The *Annual* is distributed as a benefit of membership to those who were members of the BPG in the date year of the issue. Additional copies or back issues are available from AIC. All correspondence concerning subscriptions, memberships, back issues, and address changes should be addressed to:

American Institute for Conservation
727 15th Street NW, Suite 500
Washington, DC 20005
info@culturalheritage.org www.culturalheritage.org

JORDAN FERRARO

Developing a Comprehensive Approach to Light Exposure at the US Army Heritage and Education Center

INTRODUCTION

It is the responsibility of conservators to provide other museum professionals with the tools they need to ensure the stability of their collections and protect against the 10 agents of deterioration. Light is one of the 10 agents of deterioration and has been addressed by many (Ritzenthaler 1993; Thomson 2005). As many museums begin to consider whether to spare objects from fade or to sacrifice objects to tell a story (Brokerhof, Kuiper, and Scholten 2018), it is even more important to provide decision makers with the information and tools that allow them to understand the impact of these decisions. The US Army Heritage and Education Center (USAHEC) has developed a low-cost system that allows everyone in the museum and archive to understand and manage light exposure.

BACKGROUND

Six years ago, USAHEC and the US Army Museum Enterprise were relying on traditional light management techniques. Army regulations followed a similar format to industry recommendations, outlining three categories: high sensitivity, sensitive, and low sensitivity. Each category was given a maximum exhibit light level of 50, 150, and 300 lux, respectively. The regulations further stated that high-sensitivity and sensitive objects should be rotated on and off exhibit more frequently than other objects. The regulation did not include guidance for categorizing objects, nor did it include a time frame for "more frequently." This ambiguity led to arbitrary blanket exhibit decisions such as "no paper-based materials will be exhibited" and "all textiles have exhibit limits of 9 months." These blanket decisions did not take into account exhibit light levels or how many times items were exhibited.

Papers presented at the Book and Paper Group Session, AIC's 47th Annual Meeting, May 13–17, 2019, Uncasville, Connecticut

There was no light monitoring in exhibit spaces. Instead, exposure was tracked through the use of blue wool cards. Each exhibit case had a half-covered blue wool card to monitor exposure during exhibit. Considering that there was only one card per case and the cards were placed in the bottom of cases, sometimes in the shadow of the objects on display, the cards did not capture the true exposure of the objects in the case, nor did they tell how close an object was to noticeable fade. One card per case also meant that exposure could only be tracked for a single exhibit. For blue wool cards to track lifetime exposure, each object would have to have its own blue wool card, which would have become overly cumbersome.

Of great concern to all museum staff was the repeated exhibit of certain "favorite" objects. Many of the USAHEC exhibits are driven by nonmuseum professionals who do not understand the desire to spread light damage over multiple objects. Additionally, the USAHEC mission of telling the Army story one soldier at a time made the use of type pieces a contentious issue, as decision makers preferred to use the artifact directly related to a soldier rather than a type piece. Without a clear understanding of the effects of light on artifacts, it was difficult to steer decision makers in other directions. Clearly, a new approach was needed—one that treated all objects as the unique items they are and that treated each exhibit as a unique space.

REEDUCATION

Before a new approach could be devised, certain misinformation about light needed to be dispelled. The first piece of information that needed to be understood was the fact that light damage is cumulative. A standard of 50 lux for 3 months over 5 years has many problems and can cause confusion. It does not give finite exhibit recommendations, it does not address what happens after 5 years, and it does not give a cumulative exposure limit. Unless a museum tracks exposure beyond a single exhibit, how do conservators know how many times an object has been exhibited at 50 lux in the previous 5 years or even the last time an object was exhibited?

Removing this confusing language was essential to gaining a better handle on light exposure.

Related to the concept of cumulative damage is the misconception that "resting" a collection in dark storage can extend "light life." Just like the misunderstanding about the cumulative nature of light damage, this misconception has its seeds in traditional light standards. Standards that require rest in dark storage may lead some to believe that this resting will reverse damage. Perhaps the original purpose of these types of requirements was to allow items to be exhibited to larger audiences by spreading exhibits over larger periods of time; however, with few exceptions, resting the object will not reverse damage. Damage from exposure at 50 lux for 3 months with a 12-month rest period and then reexposure for an additional 3 months will result in the same damage as exposure at 50 lux for 6 consecutive months.

The last hurdle faced at USAHEC was the nature of light itself. An incident with case construction informed conservation that not all museum professionals understand the differences in light. At USAHEC, curators asked conservators to check the UV filtering properties of some cases. It was found that the cases were not filtering UV, and the case construction company was immediately contacted to remedy the oversight. When the "fixed" cases were installed, conservation became aware that the cause of the concern was due to an object fading on exhibit. The curators had thought that blocking the UV would eliminate any potential for fade. This misunderstanding provided conservation a good opportunity to educate museum staff on UV and visible light, how each type of light damages the collections, and the light situation in each of the USAHEC galleries. Considering that none of the galleries contain sources of UV, cases that filter UV are not necessary. Although the exclusion or filtering of UV light has always been a part of the USAHEC exhibit plan, the staff now understands the effects of UV light on collections and that visible light needs to be managed as well.

A NEW APPROACH

Developing the System

The new system developed at USAHEC utilizes the existing knowledge of the ISO Blue Wool Standard and two new tools for collecting and tracking light data. The ISO Blue Wool Standard lists eight categories of fade based on the fade rate of eight pieces of blue wool (fig. 1). The figures in the chart are the amount of exposure, in megalux, the materials in each category can withstand until a "just noticeable fade." This standard has become the basis for museum industry exhibit recommendations; however, these industry recommendations often regroup the eight categories into three or four broader categories. These broad categories are not precise enough to be useful in long-term light tracking. Grouping a category 1 object and a category 3 object into the same "high sensitivity" group can either cause the category 1 object to be overexposed or cause unnecessary rotation of the category 3 object.

With the new system, USAHEC went back to the original eight Blue Wool Standard categories as a way of determining the light life of each object. Categorization of objects is based on industry research, the conservator's knowledge of materials, and the objects' light-based deterioration. Figure 2 includes some of the materials that have been categorized by USAHEC conservators. Putting objects into a light category tells conservators approximately how many lux hours an object can withstand until a just noticeable fade. When the object reaches the just noticeable fade mark, it has reached the end of its light life.

When an object is slated for exhibit, a two-part process is undertaken to ensure safety of the objects. The first step is for a conservator to review the object and determine its suitability for exhibit. At this time, the conservator identifies the object's light life by placing it in one of the eight ISO categories. The conservator reviews previous exposure data, the proposed length of the exhibit, and the need to exhibit

	ISO #8	ISO #7	ISO #6	ISO #5	ISO #4	ISO #3	ISO #2	ISO #1
With No UV	1000	300	100	30	10	3	1	0.3
With UV	120	50	20	8	3.5	1.5	0.6	0.22
	Low Sensitivity		Medium Sensitivity			High Sensitivity		

Fig. 1. ISO blue wool categorization chart. Adapted from Michalski (2018, table 4).

Category 1 **Light life = 300,000**	**Category 2** **Light life = 1,000,000**	**Category 3** **Light life = 3,000,000**	**Category 4** **Light life = 10,000,000**
• Watercolor • Iron gall inks • Construction paper • India Ink	• Ballpoint ink • Silk • Color photos with "color" in the name • Felt-tip ink	• Textile • Wood	• Tintype • Leather • Color photographs with "chrome" in the name
Category 5 **Light life = 30,000,000**	**Category 6** **Light life = 100,000,000**	**Category 7** **Light life = 300,000,000**	**Category 8** **Light life = 1,000,000,000**
• Printer inks	• Painted wood • Acrylic paints	• Silver gelatin black and white photos • Lithographs	• Oil paintings • Metal

Fig. 2. USAHEC-developed materials categorization chart

the object in the future. The conservator then makes an exhibit recommendation based on projected exposure during exhibit. A typical exhibit recommendation at USAHEC is to not exceed half of an object's light life in any exhibit. Limiting the exposure of the object to its half-life balances the desire to exhibit with the desire to avoid noticeable fade of the object.

The second part of the exhibit process is to look at the exhibit spaces. Thanks to the efforts of previous conservators, USAHEC exhibit galleries have well-developed lighting designs. All exhibit spaces are free of all sources of UV light and direct case lighting is reduced so that most objects can be exhibited within traditional light recommendations.

When an object is placed on exhibit, the conservation team takes light readings on each object. Several readings are taken for each object to determine the brightest spot. Conservators work with exhibit staff to adjust light levels to minimize hot spots and reduce light levels to extend exhibit length while still providing viewability.

Calculating Exposure

Once the readings are taken, potential exposure is calculated by multiplying the light level by the intended exhibit length. For an object with a light reading of 70 lux in a 4-year exhibit that runs 8 hours a day, 7 days a week, the formula would be as follows. First, the number of hours on exhibit is determined by multiplying the hours per day (8) by the number of days on exhibit ($7 \times 52 \times 4$): $8 \times 7 \times 52 \times 4 = 11{,}648$ hours on exhibit. This number is then multiplied by the light reading to get exposure in lux hours ($11{,}648 \times 70 = 815{,}360$). To determine if the object can be exhibited safely for this exhibit, the projected exposure is then subtracted from the light life. If the object were a watercolor painting, it would be in category 1 with a light life of 300,000 lux. Considering that the projected exposure of 815,360 lux is greater than 300,000, the recommendation would be to remove this object prior to the end of the exhibit. In this case, conservators would need to recalculate to determine when half the light life would be reached. If the object were a Kodachrome photograph, it would be in category 4 with a light life of 10,000,000 lux. Considering that 10,000,000 is greater than 815,360, this object would not noticeably fade while on exhibit and could remain on display for the full 4 years. The results of these calculations are used to populate an exhibit light spreadsheet (fig. 3) that is shared with collections management and curatorial staff. These estimates are worst-case scenarios; reduced exposure achieved through timers or motion sensors are not included in these estimates.

Understanding the Spreadsheet

All objects on exhibit are listed on the spreadsheet by exhibit gallery and case. Columns 1 and 2 are used to identify each object. The next four columns are used to indicate the data needed to make projected exposure calculations, the install date (column 3), the projected end date of the exhibit (column 4), the light reading taken at installation (column 5), and the allowance or light life assigned to each object by the conservator (column 6). The remainder of the spreadsheet is used to convey the projected exposure data. Color coding is used to indicate the extent of fade, with light gray meaning that there is no visible fade, medium gray meaning that the object is halfway through its light life, and black meaning that the object has exceeded its light life. Column 7, "full," is highlighted when an object is able to stay on exhibit for the full length of the exhibit. The first

1	2	3	4	5	6	7	8	9	10
		Color code key		OK					
				Half life					
				Fading					
Object by Exhibit		Install Date	Exhibit end Date	Light reading	allowance	full	Now	Jul-19	Aug-19
Main Gallery									
Preserving Legacy	**Yarulis**								
	Book	Jul-18	Jul-21	70	30,000,000				
MHI2016.08.21	Opium Pipe	Jul-18	Jul-21	60	3,000,000				
MHI2016.08.20	Prayer Book	Jul-18	Jul-21	204	1,000,000,000				
Spanish American War	**Taylor**								
MHI 1898.0123.09	Cartridge Belt	Aug-15	Aug-20	116	3,000,000				
E 726 N5 71st Inf. E4 1899	Souvenir Book	Aug-15	Aug-20	127	3,000,000				
Spanish American War	**Look Down**								
FLW1996.0098	Haversack	Feb-18	Feb-21	434	3,000,000				
MHI 2012.23.15	Canteen	Feb-18	Feb-21	556	3,000,000		Feb-19		
Phillipine Insurection	**Van Dusen**								
MHI 07.36.36A-B	Wicker Helmet	Aug-15	Aug-20	48	1,000,000				
MHI 07.36.48A-B	Spear, Barbed	Aug-15	Aug-20	23	3,000,000				
MHI 07.36.52	Spear	Aug-15	Aug-20	9	3,000,000				
Mexican Border	**Fye**								
MHRC 77.05.34A	Pistol, Semi Auto	Aug-15	Aug-20	54	10,000,000				
TRAN 1978.020.020A-B	Stirrups	Dec-18	Aug-20	52	10,000,000				
TRAN 1978.020.021	Bit	Dec-18	Aug-20	46	1,000,000,000				
TRAN 1978.020.044A-D	Drafting Set	Dec-18	Aug-20	47	10,000,000				
203.6PA 1933 C.4	6th Field Artillery	Dec-18	Aug-20	79	10,000,000				
World War I	**Reynolds**								
MHI 1917.6999.01A-C	ID Disc	Aug-15	Aug-20	95	3,000,000				
MHI 1917.6999.02A-C	St. Mihiel Medal	Aug-15	Aug-20	107	1,000,000				
MHI 1917.6999.04A-YY	Housewife	Aug-15	Aug-20	66	3,000,000				
	Letter	Aug-15	Aug-20	93	10,000,000				
	Certificate	Aug-15	Aug-20	100	1,000,000		Jan-18		
	Table	Aug-15	Aug-20	117	10,000,000				

Fig. 3. Exhibit light spreadsheet

item on the spreadsheet in figure 3 is a book that was placed in category 5, which means that it will not reach a noticeable fade until 30,000,000 lux hours of exposure. After performing the calculations, it is determined that the book can be safely exhibited for the full exhibit term; therefore, the "full" column is highlighted in light gray for this item. Column 9 begins change-out recommendations. Each column to the right is a different month during which an

object will reach its half-life. The cell is highlighted in the appropriate month when an object is projected to reach its half-life. Column 8, "Now," which is updated monthly, is used for the current state of objects. Highlighted boxes in this column also have a date that indicates when the object moved into that column (in fig. 3, the canteen reached its half-life in February 2019).

Tracking After Exhibit

When an object is removed from exhibit, exposure is finalized down to the day and a light exposure worksheet (fig. 4) is filled out for each object. The total light life is indicated based on the pre-exhibit categorization. The exhibit title and date lines are filled out, and the calculated light exposure is entered. Exposure is subtracted from the total light life to get the "remaining hours till fade." This worksheet becomes part of the permanent object record and can be referenced during future exhibit planning. As the item is included in future exhibits, the exhibit information will be added to the worksheet and the exposure subtracted from the remaining hours till fade from the previous exhibit.

Post Exhibit Light Exposure Worksheet

Item Number: MHI 79.01.01

Total lux hours till Fade: 3,000,000

Exhibit #1: Treasures Exhibit
Dates: 29 April - 6 May 2015

Exposure on Exhibit: 86,400
Remaining lux hours till fade: 2,913,600

Exhibit #2: Treasures Exhibit
Dates: 7 May 2015-5 July 2017

Exposure on Exhibit: 1,036,672
Remaining lux hours till fade 1,876,928

Exhibit #3:
Dates:

Exposure on Exhibit:
Remaining lux hours till fade

Exhibit #4:
Dates:

Exposure on Exhibit:
Remaining lux hours till fade

Fig. 4. Exhibit light worksheet

BENEFITS OF THIS NEW APPROACH

This new system has brought a new understanding of light exposure to curators, archivists, and exhibit designers. Before the program, nonconservation professionals did not always understand the reasons conservators suggested limiting exhibit length for some objects but not others. Giving curators and archivists a concrete visual guide for each artifact reinforces the scientific approach to collection care and shows that the recommendations made by conservation are not arbitrary. Where in the past light was only a tool to aid the viewer rather than a part of the total environment that required control and monitoring, light is now a guiding force in exhibit design and scheduling.

This understanding of light allows curators and archivists to make better-informed exhibit decisions. No longer do blanket rules restrict exhibit designs. Curators now have more flexibility in what they can include in an exhibit, which expands their ability to tell the Army story and allows the public to see a larger portion of the Army's collections. Decisions whether to sacrifice a single piece or spread the damage over several objects can be made with a clear understanding of what that decision means.

The processes established by this system have helped streamline the entire exhibit process. Initial light estimates help inform exhibit length and assist curators in preparing additional objects for change-out during the planning phase of the exhibit. The light spreadsheet helps inform change-out decisions and keep curators and exhibit designers on a change-out schedule. The light exposure worksheet gives a clear record of exhibit history that provides a better understanding of how the collection is used and allows curators to make decisions that reduce damage to overexhibited objects.

An unexpected benefit of this new approach is an easing of the exhibit change-out schedule. Many curators believed that this procedure would lead to increased change-outs and more work for the exhibit staff. Instead, it was discovered that many of the objects could remain on exhibit for longer than originally thought. This new approach means targeting change-outs to the artifacts that will actually be damaged by prolonged exposure, giving curators the ability to create static or permanent exhibits using lightfast material.

The creation of a comprehensive light program that includes cumulative light exposure tracking is an essential task for any museum wishing to avoid noticeable fade to displayed material. It greatly reduces the impact of one of the 10 agents

of deterioration, and it can foster a greater understanding of what conservation professionals aim to achieve—the long-term stability of collections.

REFERENCES

Brokerhof, Agnes, Pieter Kuiper, and Steph Scholten. 2018. "Spread or Sacrifice: Dilemma for Lighting Policies." *Studies in Conservation* 63 (suppl 1): 28–34.

Michalski, Stefan. 2018. "Agent of Deterioration: Light, Ultraviolet and Infrared." Canadian Conservation Institute. Accessed September 1, 2019. https://www.canada.ca/en/conservation-institute/services/agents-deterioration/light.html#uv6/.

Ritzenthaler, Mary Lynn. 1993. *Preserving Archives and Manuscripts*. Baltimore, MD: Port City Press.

Thomson, Gary. 2005. *The Museum Environment*. 2nd ed. Burlington, MA: Elsevier Butterworth-Heinemann.

FURTHER READING

ANSI. 1996. *Museum and Art Gallery Lighting: A Recommended Practice*. RP-30-96. Approved May 13, 1996. New York, NY: ANSI.

ANSI. 2017. *Recommended Practice for Museum Lighting*. RP-30-17. Approved January 1, 2017. New York, NY: ANSI.

JORDAN FERRARO
Paper and Preventive Conservator
US Army Heritage and Education Center
Carlisle, PA
jbferraro@gmail.com