

Ultraviolet Protection: Choice and Install

Choosing and Installing Ultraviolet Protection

Each type of ultraviolet product has benefits as well as disadvantages. A ‘blanket’ approach may not be the best option and some installations can cause significant harm to other features of the building. Cost can also serve as a major factor for selection.

Guidelines for Choosing Ultraviolet Protection

- Materials and products should be chosen on a case by case basis in conjunction with the collections team based on the needs and use of the room.
- The material used for ultraviolet protection should be chosen based on the performance qualities of each. The four types commonly used by Historic New England are:
 - Films
 - Shades (or other window treatments)
 - Acrylic, polycarbonate, or polyester plastic panels that include UV protection
 - Storm Windows (Interior/Exterior)
- The materials used should also take the following into consideration:
 - Location
 - Use of the Room
 - Contents of the Room
 - Types of Windows/Doors
 - Cost
 - Location

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Technical Information on Choosing and Installing Ultraviolet Protection

To suppress fading damage, installations have often included lined draperies and curtains, shutters, tinted or reflective glass, or dark window films. While all of these "solutions" reduce the damage, they also prevent light from passing freely through the window, negating much of the value of having windows in the first place. Also, many of these solutions are inappropriate for historic house museum settings, as some applications can dramatically alter the appearance of windows from both inside and outside.

The high intensity of light through the glass induces chemical reactions which deteriorate materials like textiles, wallpaper, photographs, and artwork causing them to fade, discolor, and eventually break apart. Light also generates heat, which structurally weakens window frames and degrades unpainted wood. As period collections are essential to the organization, Historic New England has researched and experimented over the years with several different applications of protection in order to mitigate the effects of damaging ultraviolet rays.

Since the 1970s, Historic New England has been installing different types and designs of ultraviolet light protection, including clear, acrylic panels, roller shades, and UV film. Some installations appear to cause no harm, while others appear to cause serious harm—with factors including the age of the installation, window orientation, installation details, and the overall humidity levels of the room. In several applications, the UV protection promotes heat build-up in the air space between the historic glass and protective coating causing condensation and accelerated deterioration of the muntins and bed glazing.

In the last 20 years, the market has become saturated with manufactures, labels, and product names for UV protection materials, but there are four basic types that can be broken down into the following:

- Films
- Shades (or other window treatments)
- Acrylic, polycarbonate, or polyester plastic panels that include UV protection
- Storm Windows (Interior/Exterior)

The types may be simple, but the products and installations can range considerably, many of which can be inappropriate for historic buildings. Unfortunately, not all products meet museum standards, and often manufacturing literature is confusing and misleading. It is important to consult with Historic New England's Collections Team before purchasing any products.

Films

Plastic films are commonly adhered directly to the pane of glass, however, some films are made into rigid sheets that can be attached as a roller shade. Films can be designed to reflect sunlight and keep interiors cool. Others strengthen glass and help prevent damage from vandalism or earthquakes. Still others filter various parts of the light spectrum—though all may not filter the full range of UV radiation as required for museums.

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One of the major drawbacks of traditional window films is that they tend to act like mirrors. From the inside, these films make it difficult to see outside, especially at night when interior lights are on. In the daytime, the outside reflection tends to give a home the look of a commercial building. It is important to find a film that offers less interior reflectivity than the glass they cover. Also, until recently, most window films that rejected heat were tinted dark—giving an almost purple look. These films used metal and were highly susceptible to corrosion, especially in coastal environments. While these types of films were able to achieve improved performance, their drawbacks made them unacceptable for most museum applications.

Specified and installed properly, however, films become virtually invisible, which could be an advantage in certain historic interiors. But they may not be appropriate for all windows, particularly very old glass. Eventually they need replacing, and must be removed using solvents and elbow grease. The process can break or scratch old glass, and the solvents can damage paint or finishes.

Installing Film

Films are purchased in long rolls that can be easily cut. The adhesive is placed on the glass, the film is placed over and cut with a sharp knife to the correct size, and then the film is smoothed with a squeegee-like tool to eliminate wrinkles. Manufacturers normally require that the film be installed by a certified dealer in order to maintain the intended warranty. If installed improperly, some films can crack, craze, peel, blister, bubble, and/or delaminate from the glass. Most warranties, however, will cover these rare issues.

Shades (or other window covering)

Window treatments can also protect historic interiors and add to the lifespan of the valuable possessions by blocking the sun's damaging UV rays with fabrics or plastics that hang over the openings. But heavy lined drapes and interior shutters may not be appropriate to the museum's interior or may be the exact collection pieces that need to be preserved.

Shades can be another option for protection and generally come in three different types—solar shades, blackout shades, and exterior shade screens.

Solar shades are light filtering that blocks some UV radiation while allowing light to pass. Most solar shades are comprised of a combination of PVC-coated fiberglass and polyester yarns, which results in a relatively low light blocking and high view-through material. A light filtering shade is rated by the openness of the fabric (usually 3%-14%), which is a measurement of how much light can come through the mesh material. The greater the number, the greater amount of light is allowed to pass, the better one can see through the shade, and the more UV radiation can enter the room.

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Blackout shades block more of the harmful UV rays than light filtering shades. Characteristically, blackout shades are comprised of a somewhat tough material made from plastic, vinyl, fiberglass or a mixture of any of those materials. Often, blackout shades are sold in conjunction with another style of shade like a honeycomb or a bamboo shade and can move in conjunction with or independently. Many historic house museums have installed this “double-shade” system, which allows light to pass during the museum’s open hours but still blocks some UV radiation.

Shade screens are exterior shades that install like insect screens on the outside of the window sash. These blinds roll down over the outside of the window, preventing any radiant energy from entering. They have major drawbacks, however; they block the light, views, ventilation, they have to be adjusted manually, and they can radically change the exterior appearance of the building.

As mentioned above, museums can also buy the rigid plastic films incorporated into roller blinds that attach in a similar fashion as fabric shades. This application can be desirable because it allows the most visibility. Unfortunately, they may change the appearance of the historic house museum from the exterior as they can appear ‘crinkly’ or wavy if not closed properly.

It is important to note that many shade manufacturers’ claims of filtering out UV radiation are based on the shades being installed over double-glazed glass windows, which most museums do not have. And they do not provide protection unless they are fully lowered or closed.

Installing Shades

Shades are quick and easy to install and do not require special certified installers. The most accepted installation is with inside mounted brackets, which virtually disappear when the shade is in place. To operate properly, however, the fabric on the shade can be up to 1 ½” narrower than the width of the opening. Light seepage on the sides of the shade is inherent to the design. To reduce light seepage, museums may choose to install it with an outside mount—over the frame of the opening. This installation, however, could interfere with historic drapes or curtains and may not be feasible.

Acrylic, Polycarbonate, or Polyester Plastic Panels (including UV protection)

Plastic panels are one of the most inexpensive and effective ways to protect the interior contents from UV radiation. Modern plastics that contain UV absorbing coatings can reduce the radiation by roughly 99% while completely maintaining the natural light.

However, installation procedures for plastic panels vary considerably, many of which cause significant harm to the sash due to improper fasteners or trapping heat between the sash and panel causing condensation. The plastic panels are highly susceptible to scratching, hazing, and become brittle and yellow over time. Though the UV coatings on the plastic panels do not degrade, the plastic itself will degrade from the radiation. Depending on installation method, plastic panels can be difficult to remove, which

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competes with housekeeping—especially when insects get trapped between the plastic panel and sash. Also, special products are required to clean the panels to reduce scratching.

In several applications of UV panels since the 1970s, the UV protection has promoted heat build-up in the air space between the historic glass and protective coating causing condensation and accelerated deterioration of the muntins and bed glazing. Condensation is the result of a simple law of physics. Vapor will turn to liquid when it comes in contact with any surface that is at its dewpoint or lower. The dewpoint is determined by the air temperature, its pressure, and the amount of water vapor in the air (relative humidity). Condensation is extremely damaging to historic wood windows. Though, in some cases, condensation can not be avoided, installing plastic panels or storms without proper venting can exacerbate the issues causing significant damage to the building structure.

It is important to note that plastic coatings can come in a variety of protections—including UV, non glare, and anti-reflective—but not all coatings are effective in blocking the radiation.

Installing UV Plastic Panels

Plastic panels containing UV protection coatings can be installed in a variety of ways. Plastic sheets can be installed on the interior by hanging from hooks, attached with screws, or set into place with u-shaped clamps. It is extremely important that these interior installations allow for proper ventilation. As the sun's radiant heat enters the glass it is blocked by the interior plastic panel; gets stuck within the space between the plastic panel and the sash and creates a microclimate. The result is significant amounts of condensation that can roll off the glass and deteriorate the bed glazing, interior paint, and wood muntins.

Another form of installation is cutting the plastic panel to the exact size of the individual pane of glass and attaching it with glazing points. Although this seems to reduce or eliminate the microclimate created by the full sheets of plastic, the installation may be impractical for large, multi pane windows.

Storm Windows

Storm windows can be comprised of glass or plastic and can be installed on the exterior and/or the interior of the building. Generally storm windows cover the entire opening—including frames and can be fastened in a variety of ways. Many times they are used as extra protection for large windows against high winds or the potential for vandalism.

Ideally, a window would block the damaging UV rays, while letting light to pass through. Ordinary clear window glass, however, lets in about 70% of the sun's UV radiation.¹

¹ Conserve O Gram: *Choosing UV-Filtering Window Films*. The National Park Service: Washington, D.C. Number 3/10, 2001.

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Therefore, the most effective ways to reduce the sun's heat and harmful rays is to stop it before it passes through the glass and enters the building. New varieties of high-performance clear window glass can be installed on the exterior and provide some protection from UV radiation—two examples are low-emission glass and laminated glass.

Low-emission glass (Low-E) is a clear glass product coated with microscopically thin layers of metallic oxide that is bonded to the surface. The metals are so thin that they are see-through yet prevent heat and UV from passing through while at the same time blocking heat from leaving the room, reducing heat loss considerably. Emissivity is a measure of how much radiant heat is transferred by the glass surface. The less radiant heat transferred the better for the museum. The glass stays warmer, so moisture is a lot less likely to condense on the inside of the window. The downfall of Low-e coatings is that they are designed to keep heat in but do not keep it out, therefore, summer heat can strain HVAC systems, if applicable.

Laminated glass is a sandwich made of one piece of plastic Poly Vinyl Butyral (PVB) between two or more glasses. The PVB sticks with the glass and forms chemical as well as mechanical bonds. It gives acoustic insulation as well as gives protection against damage caused due to UV radiation. Unfortunately, the material has one unattractive characteristic: if PVB absorbs moisture, the foils cloud up and can vastly reduce the visual appearance of the window.

Installing UV Storm Windows

Storms can be installed in a variety of ways. Most storms have a frame comprised of metal, wood, or plastic that needs to be fastened to the interior and/or exterior frame of the window. Poor installation or the use of improper fasteners can greatly damage or weaken frames so care should be taken in specifying fasteners.

It is extremely important that storms be installed with proper ventilation to eliminate condensation issues. Ventilation methods should be carefully planned with an airspace that allows for any condensate to evaporate, equalizes air pressure, and minimizes the temperature gradient.

Museums with severely drafty windows or windows that experience a lot of condensation, may choose to install a double UV storm application—attaching one storm on the exterior and one storm on the interior. Unfortunately, storms will eliminate most of the natural ventilation unless removed in the summer, which negates the UV protection during those months.

Exterior storms have significant drawbacks; they can negatively affect the aesthetics of the house due to glare, which would conceal the window's decorative tracery and historic shadow lines. And storms should not be seen as a substitute for repair, restoration, or maintenance. Installations should be researched and presented to the *Proactive Preservation and Interpretation Planning* Committee before proceeding.

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Location

- Generally, the south, west, and east elevations get the most intense light depending on time of year.
 - For east, west, or south windows, consider exterior roll blinds in rooms that are unoccupied during the day.
 - Interior window shades are also an option but light seepage on inside mounted shades can be a problem in these areas.
 - Films can be installed safely.
 - Plastic panels should be well ventilated on these sides as heat build-up can be intense.

- The north side is where multiple panes and airtight windows are most crucial in winter.
 - The north side gets little direct sunshine, and the north wind is often the coldest.
 - Low-e storm windows with good insulating values can face north without losing much heat.
 - Films could also be applied to north facing windows that may aid with maintaining the radiant heat.
 - Installations of plastic panels on the north side, however, should be carefully planned as this side is most susceptible to condensation issues.

Use of the Room

- Office spaces in historic house museum may not need or require UV protection on windows.
- Storage rooms that are not open to the public but only provide space to store office supplies or collections can use a less aesthetically pleasing method for UV protection, like blackout roller shades mounted directly on the frame to block light seepage from the sides.

Contents of the Room

- Spaces with special collections, such as delicate wallpapers, hooked rugs, and/or fragile textiles may require a more expensive approach to eliminate all UV radiation.
- Rooms with only reproductions or few collections may not require the same level of protection.
- Rooms that include features like chimneys that may add to the relative humidity to a room can be prone to condensation issues.
 - Careful planning for UV protection is required in these rooms—such as UV films, exterior storms, or a combination of exterior and interior storms.

Types of Windows/Doors

- It may be infeasible to install film or individual acrylic pieces on windows with extremely small panes of glass, decorative tracery, or large sash with multiple panes.
- Some intricate and decorative window frames will not allow for certain applications with interior and/or exterior storm windows.

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- Historic house museums that already have wood storm windows may want to install a UV film directly on the storm instead of the sash.
- Films should only be applied to windows that have been restored.
 - Films should be avoided on very old glass due to high possible breakage.
 - Historic New England requires that broken glass that is still structurally sound, must be glued back together instead of replaced. This may cause a ‘bubble’ appearance if film is applied and can not be avoided.

Cost

- Rooms with only a few valuable artifacts (like paintings or small furniture) could be covered cheaply with black fabric when not on display to reduce the exposure of UV radiation.
- Museums can use a variety of installations based on the needs of the room, which may cut down on the cost of products.