# Choosing UV-Filtering Window Films

### Introduction

In the past 20 years, the market has become saturated with window films with different performance criteria. Some are designed to reflect sunlight and keep interiors cool. Others strengthen glass and help prevent damage from vandalism. Still others filter various parts of the light spectrum. The films that have been of interest in museums are the so-called "solar" screens that filter part or all ultraviolet (UV) radiation. Unfortunately, not all of the solar films meet museum standards, and the product literature available from the manufacturers is very often confusing and sometimes misleading.

### Electromagnetic Spectrum

To understand how these films perform, you need to know something about the light spectrum itself. Light—both visible and UV—is a very small part of the electromagnetic spectrum, which ranges from cosmic rays on the short-wave end, to radio waves on the long-wave end. All forms of electromagnetic radiation are classified according to wavelengths. Wavelengths are measured in nanometers (nm). A nanometer is one billionth of a meter.

The only part of the light spectrum we can see is the visible segment (between 400 and 760 nm). We are all aware, however, of the harm done by UV radiation. This is the part of the spectrum that we try to eliminate completely in a museum setting.

The atmosphere filters the shorter end of UV radiation. Window glass filters a bit more, so we are only concerned about the radiation with wavelengths from about 325 to 400nm. Almost any solar film on the market filters to about 380nm. Very few films filter the **complete** UV spectrum. Most of the product literature for solar films states "98% of UV filtered." The question is 98% of what? Although not stated in the product literature, most films filter 98% of UV in the range of 325 to 380nm. For a museum, this is not enough.

There is another source for confusion. We don't measure UV in a museum in nanometers. The UV meters measure in microwatts per lumen (μwatts/lumen). This is a measure of the *proportion* (or percentage) of total UV in the light you are measuring.

In the late 1970s when the standards for museum lighting were first consolidated in *The Museum Environment* by Garry Thomson, the standard was based on the amount of UV radiation put out by an incandescent light bulb. That amount is between 40 and 70 μwatts/lumen, and as a result, the level thought to be acceptable was set at 50 μwatts/lumen. Since that time, technology has improved substantially, and there are light bulbs and filtration methods available that reduce UV to 5-10 μwatts/lumen. This is far below the commonly accepted and current NPS standard to not allow UV radiation to exceed 50 μwatts per lumen.

### How do you find the right film?

Sources for all of the films tested as part of this study are listed at the end of this *Conserve O Gram.* Also check *Tools of the Trade* and Technical Note 4 of the NPS CD *Exhibit Conservation Guidelines* (Department of Conservation, Harpers Ferry, WV, 1999) to locate suppliers. Be aware that films vary by batch, and that you should always test a sample of the film prior to installation to make sure that it is performing to standard. You can test the

film over a window or over a fluorescent lamp. Make sure to block out the light around the film so that the reading from your meter is accurate. (Put the meter directly against the film to make sure that you are not measuring light that isn't being filtered.)

A "Crawford-type" meter that uses a dial only gives a range instead of a specific number of µwatts/lumen. In general, if a film is performing to standard, you won't be able to get a low number reading on a Crawford meter because the film is filtering all of the UV that the meter can read. This means that the film meets museum standards. The newer, electronic meters give a specific number of µwatts/lumen. This figure should be at 50 or, preferably, lower.

### *Evaluation of UV Filtering Films*

Museum Management Program (MMP) staff requested film samples from the manufacturers listed at the end of this *Conserve O Gram.* Each film was tested using the above instructions. An Elsec Model 752 UV meter and Gossen Panlux Electronic 2 light meter were used to take measurements from a MMP office window registering 1200 foot candles of light and 2000 µwatts/lumen of UV without filtration. Results of the readings from the film tests are listed on the chart following.

### *Other Film Characteristics*

In addition to the filtering capability, there are aesthetic choices to consider when choosing films. Some of the films that are effective in controlling UV have metallic surfaces or are very dark colors. These would be inappropriate for a historic house. Other film characteristics such as shatter resistance, may be desirable, but unavailable on films that filter the full range of UV light.

The effects of UV radiation on museum collections can be eliminated with the technology we have available today. Compared to other forms of environmental control and with an effective life of 8-15 years, purchase and installation of UV filtering films on windows and in front of artificial light sources is a relatively inexpensive aspect of collections care.

*NOTE: For the long-term preservation of museum objects, you must control the light intensity and duration of light exposure in addition to UV radiation. See Museum Handbook, Part I, Chapter 4: Museum Collections Environment, for further information on monitoring and controlling light.*
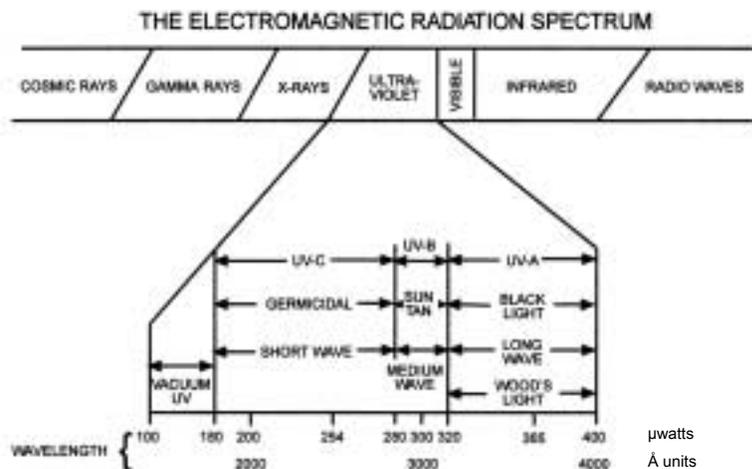


**Figure 1.** Electromagnetic Spectrum (reproduced with the permission of Spectronics Corporation of Westbury, NY)

| Company Name | Model Number | Visible Light in footcandles (light source measured 1,200 fc) | Ultraviolet light in Microwatts per lumen |
|---|---|---|---|
| ATOFINA | UF3 | 1000 | 0 |
| | UF4 | 1000 | 0 |
| | UF5 | 1050 | 0 |
| Read Plastics | .125OP2 | 1100 | 0 |
| | .125OP3 | 1050 | 0 |
| Solar Screen | Tscreen 5100 | 53 | 250 |
| | Tscreen 5110 | 120 | 300 |
| | Energy Screen | 550 | 75-100 |
| | NATTEc1500 Linen 0220 | 410 | 120 |
| | NATTEc1500 Bronze 0606 | 80 | 300 |
| | MScreen 6003 | 25 | 250 |
| | Mscreen 6005 | 40 | 275-300 |
| | Clear EZ Bond | 1100 | 0 |
| | KoolVue Silver/Silver | 350 | 50 |
| | KoolVue Smoke/Silver | 130 | 350 |
| | KoolVue Bronze/Silver | 135 | 100 |
| | KoolVue Smoke tint | 380 | 25-50 |
| | KoolVue Green/Green | 200 | 25-50 |
| | KoolVue Blue/Blue | 140 | 50 |
| | KoolVue Smoke/Smoke | 100 | 150 |
| | KoolVue Black/Gold | 95 | 100 |
| | KoolVue Black/Bronze | 120 | 25-50 |
| | KoolVue Bronze/Bronze | 145 | 25 |
| | KoolVue Mauve/Mauve | 110 | 150 |
| | KoolVue Industrial Strength | 28 | 0-25 |
| Sun-Gard Northeast | RLW150E15 DSP SCR | 290 | 75 |
| | RLW150BL15 DPS SCR | 190 | 200 |
| | RLWX150015 DPS SCR | 240 | 100-125 |
| | RLW150B15 DPS SCR | 160 | 150 |
| | NRW200BLACKOUT DPS | 1.2 | 250-300 |
| | NRW100MATTE DPS | 1100 | 125 |
| | NRW100WHITE-OUT DPS | 750 | 0-25 |
| | RLW150DN33 DPS SCR | 400 | 100 |
| | RLW150DECORATORNEUTRAL50 | 510 | 100 |
| | RLW150DN20DPS SCR | 210 | 50 |
| | SOLAR 60 | 700 | 100 |
| | SOLAR SILVER 35 | 600 | 100 |
| | SOLAR 15 | 360 | 125 |
| | SIGNATURE 60 | 750 | 120 |

| | | | |
|---|---|---|---|
| | SIGNATURE 45 | 550 | 100 |
| | CENTURY SIGNATURE 35 DPS | 460 | 100 |
| | SIGNATURE 20 | 260 | 100 |
| | CENTURY NOVA 35 | 650 | 100 |
| | CENTURY NOVA 50 | 800 | 100 |
| | CENTURY NOVA 70 | 280 | 100 |
| | GGL 12300 C90 PS SCR | 1100 | 75 |
| | GG 700 C90 PS SCR | 1100 | 75 |
| | GG 400 C90 PS SCR | 1100 | 50 |
| | GG 200 C90 PS SCR | 1100 | 100 |
| 3M | LE50AMARL | 900 | 450 |
| | LE35AMARL | 650 | 500 |
| | RE35AMARL | 800 | 500 |
| | RE50NIARL | 700 | 400 |
| | RE65NIARL | 850 | 375 |
| | RE70NEARL | 900 | 375 |
| | RE35NEARL | 490 | 375 |
| | RE50NEARL | 650 | 375 |
| | SCLARL150 | 1250 | 350 |
| | SH7CLARL | 1250 | 350 |
| | ULTRA600 | 1200 | 350 |
| | SCLARL400 | 1200 | 350 |
| ShatterGard | MuseumGARD | 1000 | 350 |
| | 6 Mil Clear | 1100 | 75 |
| | 9 Mil Clear | 1100 | 400 |
| | 6-9-12-15 Ml Clear or Tinted | 800 | 70 |
| | 15 Ml Clear | 1100 | 400 |
| Madico | SRS-220 | 340 | 100 |
| | SRS-330 | 510 | 150 |
| | RS-440 | 600 | 100 |
| | RS-550 | 700 | 100 |
| | NG-20 | 105 | 100 |
| | NG-35 | 490 | 150 |
| | NG-50 | 550 | 100 |
| | SB-221 | 300 | 100 |
| | SB-341 | 550 | 75 |
| | SB-551 | 650 | 100 |
| | SG-220 | 310 | 100 |
| | SG-330 | 440 | 125 |
| | SG-340 | 510 | 100 |
| | SG-550 | 700 | 100 |
| | TSG-335 | 530 | 25 |
| | TSG-550 | 570 | 0 |
| | SDSS-220-X | 330 | 25 |
| | SDSS-330-X | 510 | 0 |
| | DBB-220-X | 220 | 75 |
| | RS-220-XSR 4-M | 380 | 50 |

| | | |
|---|---|---|
| RS-440-XSR 4-M | 650 | 50 |
| SRS-220-XSR 8-M | 360 | 50 |
| RS-440-XSR 8-M | 600 | 50 |
| NG-50-XSR 4-M | 510 | 50 |
| NG-70-XSR 4-M | 800 | 50 |
| NG-50-XSR 8-M | 550 | 100 |
| RMS-220-X 2-M | 300 | 50 |
| MT-200-X-WHITE 2-M | 1200 | 50 |
| MT-200-X-BRONZE 2-M | 320 | 50 |
| MT-200-X-GRAY 2-M | 270 | 50 |
| CLS-200-X | 1150 | 50 |
| CL-200-X | 1150 | 100 |
| CL-400-X | 1100 | 175 |
| LCL-600-XSR | 1150 | 150 |
| CL-700-XSR | 1150 | 150 |
| LCS-800-XSR | 1150 | 100 |
| TA-81-XSR | 750 | 75 |

## *Suppliers*

Atofina
2000 Market Street
Philadelphia, PA 19103-3222
215-419-7000
<http://www.atofinachemicals.com>

Read Plastics
12331 Wilkins Avenue
Rockville, Maryland 20852
301-881-7900

Solar Screen Corporation
53-11 105th Street
Corona, New York 11368
800-347-6527
<http://www.solar-screen.com>

Sun-Gard Northeast
82 Mill Plain Road
Danbury, Connecticut 06811
800-345-6669
sgne@juno.com
<http://www.sun-gard.com>

3M Company
Construction Industry Center
3M Center
St. Paul, Minnesota 55144
800-364-3577
<http://www.3m.com/market/construction/html/
h_index.html>

ShatterGARD
888-306-7998
<http://www.shattergard.com>

Madico, Inc
64 Industrial Parkway
P.O. Box 4023
Woburn, Massachusetts 01888
781-935-7850
<http://www.madico.com>

Melanie Pereira, Intern
Sara J. Wolf, Conservator
Museum Management Program
National Park Service
Washington, DC  20240