

# Ultraviolet Radiation and the Eye: Complete Protection Requires Blocking Both Transmission and Backside Reflection

New research shows that effective protection from the serious hazards of ultraviolet radiation (UVR) requires that clear, photochromic, and tinted/polarized lenses protect wearers from both transmitted and reflected UVR.

Chronic exposure to the ultraviolet radiation in sunlight has been implicated in a number of serious ocular diseases, including pterygium, cataract, and climatic droplet keratopathy; and recent research has uncovered new, unexpected risks to the eyes. Unfortunately, the public remains dangerously under-informed about the nature and degree of this risk as well as the circumstances in which eye protection is most necessary.

## Unexpected Risks

Recent research has shown that the time of maximum risk for UVR damage to the eyes is very different from the time of maximum risk to the skin. Risk to the skin is greatest when the sun is highest in the sky—ie, at solar noon and on the summer solstice (June 21st).

But because the eyes are deep set in the orbit, they are partially protected when the sun is high in the sky; so direct ocular UVR exposure is greatest when the sun is somewhat lower in the sky. For spring, summer, and fall, maximum ocular UVR exposure occurs between 8:00AM and 10:00AM, and between 2:00PM and 4:00PM.<sup>1</sup> These, however, are not the times that people are most likely to wear sunglasses.<sup>1</sup>

## Side and Back Exposure

Even when the sun is high in the sky, the eye is exposed to a significant amount of UVR that is scattered by clouds or reflected by surrounding surfaces (Figure 1). This in-

direct radiation is responsible for nearly half of the UVR we receive.<sup>2</sup>

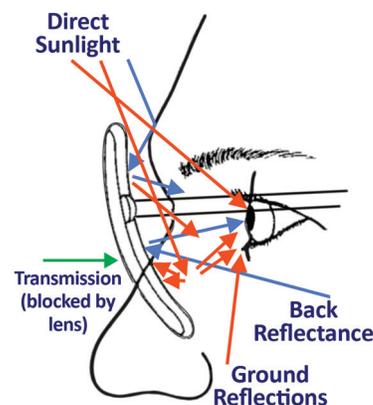
Most higher-quality sun, photochromic, and clear spectacle lenses effectively block the transmission of UVR, so UVR coming from in front is not usually an issue for people wearing glasses. But eyes still need to be protected from the significant amount of UVR that is reflected off the backside of clear, photochromic, and tinted/polarized lenses (Figure 1).

## Measuring Protection

Existing regulatory norms for UVR blocking are designed for sunglasses and are based solely on how much perpendicularly incident UVR passes through the lens; they do not take into account the substantial amount of UVR that comes from the side and is reflected off the backside of the lens. Nor are they applied to clear lenses, where UVR protection is equally, if not more, important.

Research by Karl Citek, OD, PhD, has found that while lenses treated to be anti-reflective transmit almost all of the visible light spectrum, they actually reflect over 25% of the incident UVR.<sup>3</sup> So even lenses that block its transmission can reflect UVR into the eyes when the source is not directly in front of the wearer.<sup>3,4</sup>

With this important information in mind, a new index, the Eye-Sun Protection Factor (E-SPF), was created. Like the refer-



**FIGURE 1** Note that UVR blocking can effectively eliminate transmission through the lens, but UVR can still enter the eye from the side by reflection from the backside of the lens. Up to now, all antireflective treatments have increased backside reflection of UVR (although they markedly reduced reflection of visible light).

ence index for skin care products, it measures the degree of protection provided by a lens. Unlike transmission data alone, however, the E-SPF measures total protection by integrating reflected UVR data with transmission data (see box).

## What Patients Need

Knowing what we now do about sources of UVR exposure, it becomes apparent that for everyday protection, clear lenses and sun lenses must offer UVR blocking of both transmission and reflection. To address this need, a new generation of Crizal® antireflective lenses (launching in 2012) has been engineered to virtually eliminate UVR reflection from the backside, for a lens that truly maximizes UVR protection.

## REFERENCES

1. Sasaki H, Sakamoto Y, Schneider C, et al. UV-B exposure to the eye depending on solar altitude. *Eye Contact Lens*. 2011;37(4):191-5.
2. Baldy C, Greenstein V, Holopigian K, et al. Light, Sight, and Photochromics. Pinellas Park, Florida: Transitions Optical Inc. 2002.
3. Citek K. Anti-reflective coatings reflect ultraviolet radiation. *Optometry*. 2008;79(3):143-8.
4. Citek K, Andre B, Butler JJ, et al. The eye and solar ultraviolet radiation: new understandings of the hazards, costs, and prevention of morbidity. Report of a roundtable held at the American Optometric Association Meeting; June 2011; Salt Lake City, UT.



## The Eye-Sun Protection Factor (E-SPF)

The reference index utilized in the skin care industry tells consumers how well a sunscreen protects skin from UVR; but although UVR protection is as important for the eyes as it is for the skin, we have no similar system to compare the total UVR protection of different lenses. Aiming to develop an index for eyewear similar to the system for sunscreens, Essilor scientists, in conjunction with an independent third party expert, have created the Eye-Sun Protection Factor (E-SPF).

By incorporating measurement of both UVR transmission and backside reflection, the E-SPF provides a simple but effective way to grade the total protection offered by a lens: higher values of E-SPF indicate greater levels of protection against damaging UVR.