ZEISS Vision Care

UVBlock - Measuring UV protection in clear lenses to 400nm

UV Radiation (UVR) extends to 400nm

For decades, lens manufacturers and ECPs believed that as long as clear eyeglass lenses met the 380nm industry standard for UV Protection, they were doing right by their patients.

Unfortunately, the truth is that 4 out of 5 lenses sold today fall short of the 400nm threshold for UV light used by the World Health Organization, multiple medical and scientific institutions, and commonly seen with premium sunglasses. While the spectral "gap" between 380 and 400nm *(Figure 1)* may not sound like much, it actually accounts for 40% of total UV irradiation received from the sun at sea level. Over a lifetime, this is a significant amount of harmful UV exposure that can cause not only premature aging of the skin around the eyes but also more severe conditions such as cataracts and cancer.

Recently, ZEISS decided to re-examine industry practices relating to UV Protection based on the growing body of scientific evidence that shows just how dangerous UVR up to 400nm is to our eyes and skin. One recent study is especially interesting suggesting a much larger threat from wavelengths longer than 380nm than previously thought[1]. Meanwhile, advances in technology made it possible to finally manufacture clear lenses that block UV light up to 400nm.

ZEISS is proud to announce its newest innovation: UVProtect Technology. All ZEISS branded clear plastic lenses now come with UV Protection to 400nm as standard.

Existing Standards are Inadequate

The international ISO standard ISO 8980-3, and the American ANSI Z80.1-2015 ophthalmic standards have both adopted 380nm as the upper limit for UVR, even though virtually all other scientific and healthcare organizations define UVR as extending up to 400nm.

This means that for that ordinary lenses that block UVR up to 380nm only, lens manufacturers can claim 100% UV protection based on the 380 industry standard. But in fact they do not fully block the 40% of total UVR which reaches the earth's surface. Clearly, patients deserve a better UV standard to protect their eyes, and they also deserve a simple, objective measurement of UV blocking upon which they can safely make an informed purchase decision.

Protection Factors can be misleading

As an alternative - "UV Protection Factors" for lenses have been introduced by some lens manufacturers, these can be misleading, and are highly preferential to back-side AR coatings designed to reduce indirect UV reflections. These "UV Protection Factors" assign an equal risk rating to (1) direct UV light that comes through the lens; and (2) indirect UV which is reflected from the back surface of a lens back to the eye. However, ZEISS scientists have established that the vast majority UVR reaching the eye, comes from the direct exposure of UV going through the lens, rather than the UV light reflected off the lens back-side and into the eye area[2]. This is logical and intuitive given that the shape of the head generally obstructs most of the light that reaches the back surface of any lens. The introduction of "UV Protection Factors" has led to a surprising amount of misunderstanding in the market. 90% of Eye Care Providers surveyed incorrectly assume that "UV AR coatings" with low UV reflectance on the back surface block all or a major portion of UV rays when in fact they serve no meaningful blocking function of direct UV light at all[3].

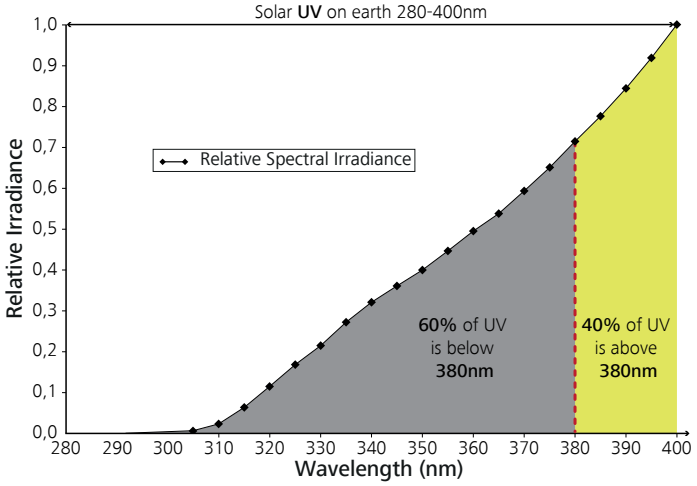


Figure 1. ISO 8980-3 solar UVR spectrum normalized to its maximum value at wavelength of 400nm

Specifications can also define a relative action spectrum (RSE) for UVR that weights each wavelength in the UV range according to its ability to cause a specific type of damage. Since there are different sites and mechanisms for UVR damage, different action spectra may be used for each. The action spectra used in ISO 8980-3 most closely resembles that for immediate erythema skin response (commonly called "sunburn"). In contrast, it is widely accepted that long-term exposure to lower levels of UVR contributes to ageing and degenerative changes in the eye, the ocular adnexa and skin. For longer-term effects, a different action spectra is required, one with a higher weighting for UVR in the range 380-400nm. Because there is no one right spectrum that covers all health effects, no RSE spectra is used in the UVBlock calculation. Meaning all wavelengths of UVR are treated equally for causing biological harm. This is also in-line with how ANSI specifications for eyeglasses and sunglasses, where no RSE is applied.

UVBlock – New measure to assess UV protection to 400nm

After reviewing the latest scientific literature, and consulting with 3rd party experts, ZEISS have defined a new UVR measure. Based on science and designed to effectively evaluate the ability of spectacle lenses to block the whole range of UVR all the way to 400nm. It is called: UVBlock.

UVBlock distinguishes itself by its simplicity and its relevance with regards to the UVR exposure for humans at sea level in daylight conditions.

UVBlock = 100% - UVR Transmittance %

The UVR Transmittance (UVτ) is defined in the formula below, which simply represents the measured UVR Transmittance between 280 and 400nm, weighted for the amount of each nm or UVR that reaches the earth at sea level. This weighting factor is the Relative Spectral Irradiance Function (ESolar) and is the same as is used in both ISO-8980-3 and AS/NZS 1067:2003 industry standards.

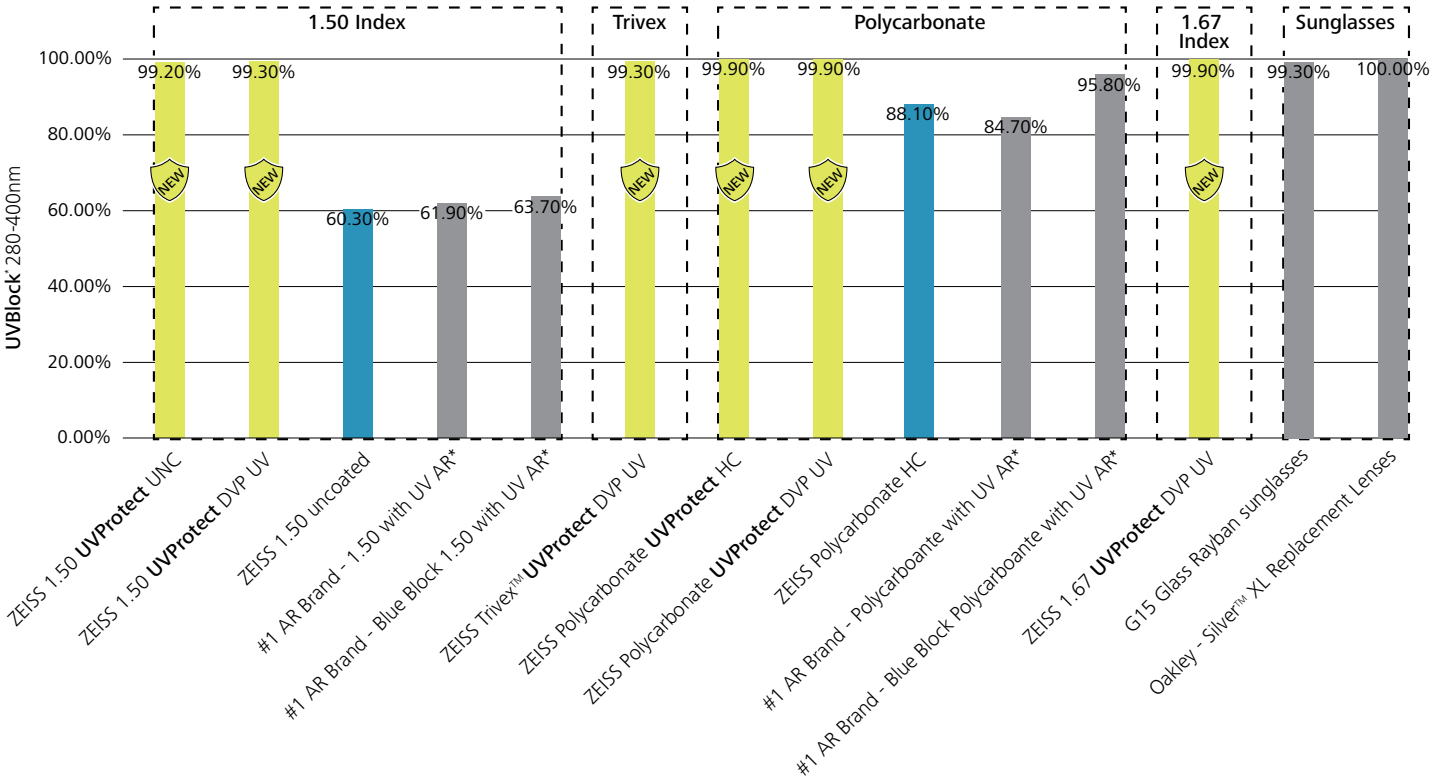
$$UV\tau = \frac{\int_{280}^{400} T(\lambda)\, E_{Solar}(\lambda) d\lambda}{\int_{280}^{400} E_{Solar}(\lambda) d\lambda}$$

In the end, UVBlock simply represents the intergrated sum over the whole UV range of the UVR blocked by any given lens, 100% UVBlock inidicates total UV Protection up to 400nm, absorbed by the material or reflected away.

UVBlock – Measurements and reported by external experts

ZEISS UVProtect lenses provide significantly more UVBlock compared to either previous generations of ZEISS lenses or to lenses from the number one AR lens brand worldwide[4], including the blue blocking substrates from this company. Even in polycarbonate only the new ZEISS UVProtect lenses achieve 100% UVBlock. This is in spite of the fact that for years, polycarbonate products have claimed 100% UV Protection based on ISO 8980-3 on ANSI standards which stop UVR at 380nm. And the typically misunderstood AR coatings, with low UV back reflectance, are shown in the results providing no or very little blocking of direct UVR.

The measurements for UVBlock results were conducted by COLTS Laboratories, and the analysis and reported values were completed by DBA Morris Vision Consulting.[5,6,7]



UNC	*Uncoated*
DVP	*ZEISS DuraVision Platinum*
HC	*Hard Coat*
*	*10 lenses measured per product, 0.00/0.00D power, measurements in 5nm increments, by COLTS Laboratories in Oldsmar, Florida (USA)*

[1] Latimer, Jennifer A., et al. „Determination of the action spectrum of UVR-induced mitochondrial DNA damage in human skin cells." Journal of Investigative Dermatology 135.10 (2015): 2512-2518.

[2] Katharina Rifai, Matthias Hornauer, Ramona Buechinger, Roland Schoen, Maria Barraza-Bernal, Selam Habtegiorgis, Carsten Glasenapp, Siegfried Wahl, and Timo Mappes, „Efficiency of ocular UV protection by clear lenses," Biomed. Opt. Express 9, 1948-1963 (2018)

[3] Jobson Research, "Kanye UV Awareness Study"- 865 Eye Care Professionals. Feb 2018.

[4] 09.11.2017: https://www.essilor.com/en/brands/crizal/
"Crizal®, the number one anti-glare lens brand worldwide*, is at the forefront of innovation."
* Best-selling anti-glare lens brand worldwide, according to Essilor's market calculations

[5] Morris, Michael, "UV Block Evaluation – Calculations of the UV Block of spectacle lenses samples sourced by Carl Zeiss Vision", DBA Morris Vision Consulting. January 2018

[6] Morris, Michael, "UV Block Evaluation – Supplemental Report: Polycarbonate and Sunglass Lenses, DBA Morris Vision Consulting. March 2018

[7] Morris, Michael, "UV Block Evaluation – Supplemental Report: High Index Materials, DBA Morris Vision Consulting. May 2018

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