Press Release

A Comparison of UV Protection in Clear Eyeglass Lenses

Study shows that UV absorbers in the lens material, such as with ZEISS UVProtect, have the greatest impact

AALEN, GERMANY, 2nd April 2019
A systematic, scientific study of different clear eyeglass lenses shows that UV absorbers in the lens material most effectively protect the eyes from UV radiation. An anti-reflective UV coating on the reverse side of the lens provides a small amount of additional protection.

How UV radiation reaches the eye

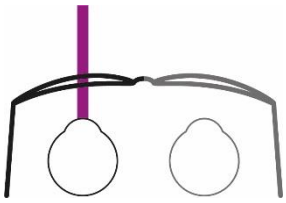
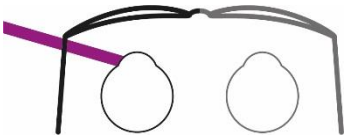
There are three ways UV radiation can reach the eye when wearing glasses: by passing through the front of the lens, by traveling past the lens from the side and entering the eye directly, or by being reflected into the eye off the reverse side of the lens (see Table 1). The largest portion of UV radiation can reach the eye from the front since the lenses offer the largest solid angle for the radiation to pass through. A recent scientific study[1] confirmed that eyeglass lenses offer the greatest potential for UV protection.[2]

The portion of UV radiation that reaches the eye and the surrounding tissue was measured on a model of the human head. Measurements were performed for different situations involving eyeglasses, both with and without UV absorbers as well as with and without a back UV anti-reflective coating on the reverse side. A simulation was then performed to validate the results.

[1] Rifai, K.; Hornauer, M. et al: "Efficiency of ocular UV protection by clear lenses." Biomedical Optics Express, Volume 9, Issue 4, Page 1948, 2018 // In this study, simulated sunlight in the spectral range of 350 – 400 nanometers was used. This range encompasses 70 percent of the UV spectrum which normally reaches us on Earth at sea level. The exposure of the eye and the ocular adnexa to UV radiation was measured. For this study, a pair of standard frames and a spectrometer were placed on the dummy. Different eyeglass lenses (with/without UV-blocking material, with/without a UV coating on the reverse side of the lens or a combination) were compared in the frames along with a pair of frames without any lenses, which served as a control group.

[2] The material studied had a 1.5 index. The control measurements without eyeglass lenses (only standard frames, no special sport frames) showed that the frames prevented approximately 18 percent of UV radiation from reaching the eye. Up to approximately 79 percent reached the eye from the front via the area normally containing lenses, and only three percent reached the eye from the side by passing between the frames and the face. With lenses, a portion of the UV radiation is absorbed. However, light is reflected off the reverse side of the lens and into the eye.

Table 1

1) Direct, transmitted UV radiation	2) UV radiation that enters from the side (traveling between the glasses and the face)	3) UV radiation that is reflected off the reverse side of the lens
		
Protection is possible *with suitable UV absorbers in the lens material*	*After selecting frames,* ***no additional protection*** *is* ***possible*** *for this portion of the incoming UV radiation*	***Protection is possible*** *with a suitable back UV anti-reflective coating on the reverse side of the lens (together with an effective UV absorber in the lens material)*
Approx. 90% of the potential incoming radiation	*Approx. 5% of the potential incoming radiation*[3]	*Approx. 3-5% of the potential incoming radiation*[4]

Top priority: the right material

Under the test conditions, the spectacles were able to block 93 percent of the UV radiation, when the lens material contained special UV absorbers like with ZEISS UVProtect. Without the additional absorbers, just 64 percent of the UV radiation was blocked by the 1.5 index material tested. The test also showed that a back UV anti-reflective coating on the reverse side of the lens for enhancing the protective material further reduces the overall UV exposure by approximately one percent. Thus, it was possible to achieve maximum protection of 94 percent in the test situation. The remaining six percent of UV radiation, which can no longer be affected after selecting frames, reaches the eye directly by passing between the glasses and the face.

The degree to which frames can prevent UV radiation from reaching the skin and eye depends on various, real-world factors like the size of the frames, their position on the face and the wearer's behavior. Spectacles can only offer complete UV protection with wrapped frames like ski goggles that provide complete coverage.

[3] Sliney, D.: "Photoprotection of the eye – UV radiation and sun glasses". In Journal of Photochemistry B: Biology 64 (2001) 166 -175. // Rosenthal F. et.al.: "The Effect of Prescription Eyewear on Ocular Exposure to Ultraviolet Radiation" in American Journal of Public Health 76 (1986) 1216 -1220. // In the study from Rifai et.al., the value was approximately three percent.

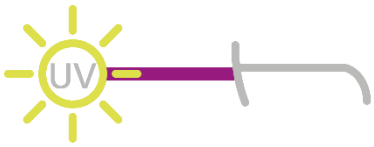
[4] Estimate; the value was one percent in the study by Rifai et al.

However, the study conducted by Rifai et al. demonstrated one thing in particular: the lens material with integrated UV protection has a significant positive effect on the eye's exposure to UV radiation. ZEISS has equipped all its clear plastic lenses with UV absorbers, which can filter out UV radiation up to 400 nanometers (the uppermost wavelength range for UVA radiation). These provide the most effective protection for the anatomic structures behind the eyeglass lens. An additional back UV anti-reflective coating on the reverse side of ZEISS lenses comes standard, as do the absorbers in the material.

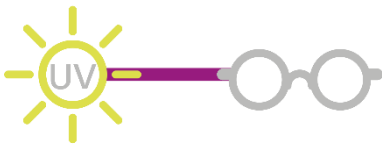
What consumers should pay attention to with UV protection

UV radiation can result in short and long-term damage to the eye. Research and clinical studies show that cataracts, for example, can develop more quickly due to repeated exposure to UV radiation. Acute UV-induced damage like photokeratitis and conjunctivitis (inflammation of the retina and conjunctiva) has also been observed. The risk stems from the fact that people do not have an innate sense for detecting UV radiation. Moreover, UV radiation is omnipresent: on cloudy day, when it rains, in every season – including those periods when people do not normally wear sunglasses. So, when selecting glasses, what should consumers pay attention to regarding UV protection?

1) **The material**: the plastic for eyeglass lenses should absorb a large portion of UV radiation, especially radiation that reaches us from the front, up to 400 nm, which is the upper limit of the UVA radiation spectrum. This applies to both clear and tinted lenses. Always remember that the tint of the lens does not indicate anything about the level of UV protection!



2) **The frames**: larger frames mean greater protection for the eye and the surrounding areas. The width of the temples can also reduce the amount of UV radiation entering from the side.



3) **A back UV anti-reflective coating** for the reverse side of the lens: this coating can prevent the small amount of UV radiation that is reflected off the reverse side of the lens from reaching the eye. However, these coatings are only effective if the lens material already absorbs UV radiation.

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For its customers, ZEISS develops, produces and distributes highly innovative solutions for industrial metrology and quality assurance, microscopy solutions for the life sciences and materials research, and medical technology solutions for diagnostics and treatment in ophthalmology and microsurgery. The name ZEISS is also synonymous with the world's leading lithography optics, which are used by the chip industry to manufacture semiconductor components. There is global demand for trendsetting ZEISS brand products such as eyeglass lenses, camera lenses and binoculars.

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