

Consultancy Report for Mr Laurie Jones, PO Box 20, Tauranga

Ultraviolet Transmission of UVTEC Coated Glass

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On 21 Feb 2001, the transmission of a sample of UVTEC coating applied to a 2.74 mm thick glass plate was tested at NIWA Lauder, Central Otago.

Two identical samples of glass were used. The UVTEC coating of thickness approximately 0.1 to 0.12 mm was applied to one of the pieces of glass using the standard application method. The other piece was left untreated.

Spectra of the zenith (overhead) sky were measured on 21 February 2001, with a spectrometer that was specifically developed for the measurement solar UV radiation received at the ground. Several spectra were obtained over a short period near local solar noon (12:30 NZST) when cloud conditions were stable and the sun elevation was approximately 55.5° (solar zenith angle, $sza = 34.5^\circ$). These spectra included:

1. Zenith sky spectrum
2. Zenith sky through the glass plate (uncoated)
3. Zenith sky through the glass plate coated with UVTEC.

The first figure shows these three spectra, plotted over the wavelength range 290-450 nm. The absolute accuracy of these measurements is estimated to be better than $\pm 6\%$, and the uncertainty in wavelength scale is less than ± 0.05 nm

The transmissions of the glass and coated glass were deduced from ratios of these spectra. The second figure shows the transmission of the uncoated glass and the transmission of the UVTEC-coated glass. The uncertainty in the deduced transmissions is estimated to be better than $\pm 2\%$.

The uncoated glass blocks most of the radiation below 310 nm, but transmits significantly at longer wavelengths. The coated glass effectively blocks the radiation in the UVA region. At wavelengths below 386 nm, it is over 100 times more effective at blocking the radiation. The improvement effected by the UVTEC coating is most dramatic at shorter wavelengths, where the radiation is most harmful.

These measurements show that UVTEC coating provides an effective protection against damage by the UV from sunlight that is transmitted by glass. In the UVB region, the coating blocked over 99.9% of the radiation that was transmitted by glass and it blocked over 99% of all UV radiation below 386 nm.

The effective blocking for three commonly reported wavelength bands is given in the table on the following page. Note that these values will depend on the glass type and thickness.

Material	UVA (315-400 nm) Transmission (%)	UVB (290-315 nm) Transmission (%)	Erythemat* UV Transmission (%)	SPF for Erythema
Uncoated glass	76.5	1.74	8.78	11.4
UVTEC coated glass	4.96	0.0016	0.14	690
Improvement factor from UVTEC coating	15.4	> 1000	> 60	> 60

- *Erythemat UV is the radiation that causes sunburn to human skin according to the wavelength sensitivity spectrum (or "action spectrum") of McKinlay and Diffey [1987].*

Exposure behind coated glass is equivalent to using a sunblock cream with SPF 690. Most sunscreens have SPFs (i.e. Sun Protection Factors) of 15 or less, similar to uncoated glass. The UV-damaging effect on other organic materials may be similar to the erythema effect.

Figures:

Upper Panel. Measured sky spectra and spectra through glass and UVTEC-coated glass.

Lower Panel. Transmission curves for glass and for UVTEC-coated glass.

Reference:

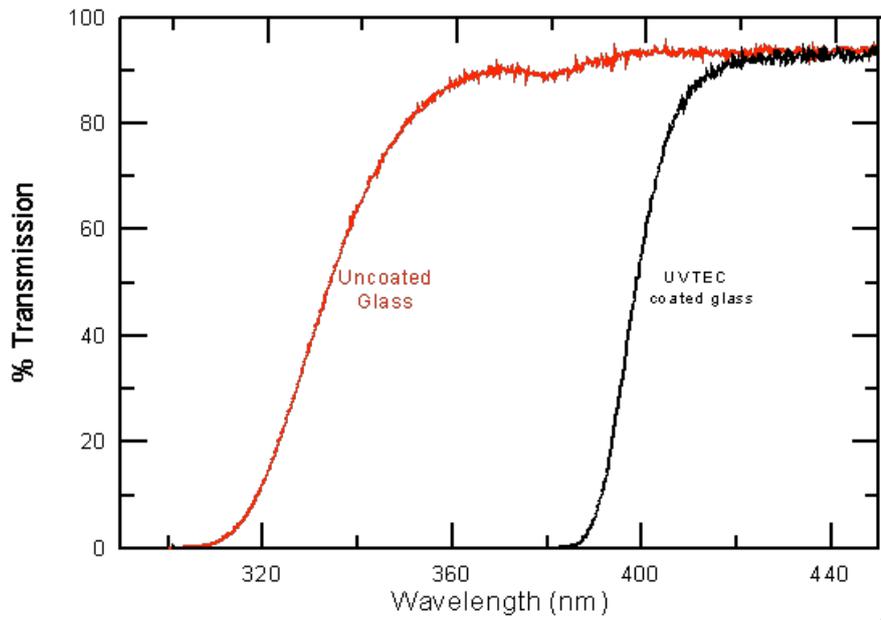
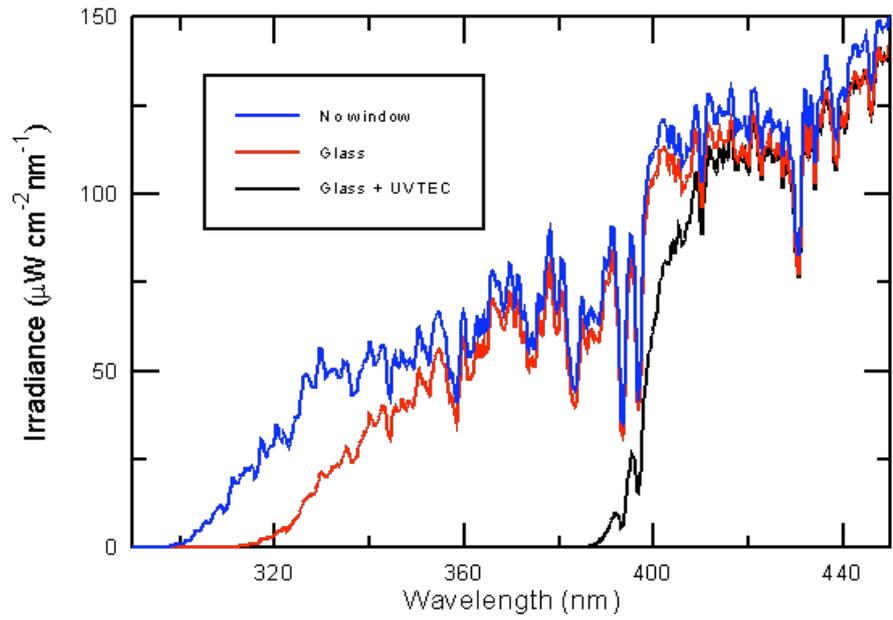
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McKinlay, A. F., and B. L. Diffey, A Reference Action Spectrum for Ultra-violet Induced Erythema in Human Skin, in *Human Exposure to Ultraviolet Radiation: Risks and Regulations*, edited by W. F. Passchier and B. F. M. Bosnjakovic, pp. 83-87, Elsevier, Amsterdam, 1987.

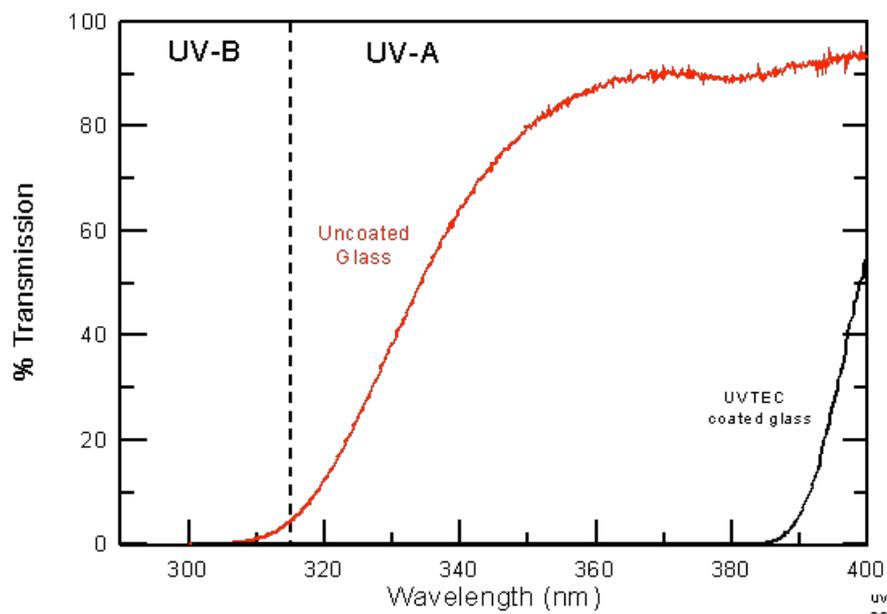
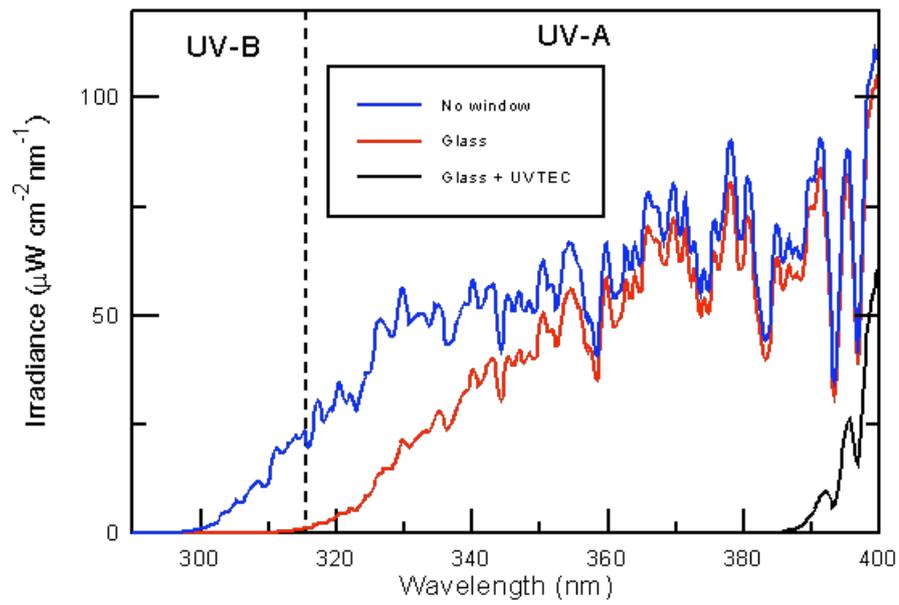
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Measurement of UVTEC transmission in sunlight at NIWA Lauder, New Zealand
12:30 NZST, 21 Feb 2001, sza = 34.5 deg, ozone = 235 DU



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