

Solar Eclipse Glasses: Are Your Glasses Safe?

For the upcoming eclipse on August 21, 2017 Guided Wave purchased some solar eclipse glasses on the Amazon website for a staff viewing party. Purchasing made sure that they had the ISO certification. A few days after the glasses were delivered we got an email from Amazon telling us that our glasses didn't come from a vendor that was verified to conform to the ISO standards and that they were refunding our money.

The Problem

We did some reading to try to understand the issues. According to the NASA website (<https://eclipse.gsfc.nasa.gov/SEhelp/safety2.html>):

The solar radiation that reaches the surface of Earth ranges from ultraviolet (UV) radiation at wavelengths longer than 290 nm to radio waves in the meter range. The tissues in the eye transmit a substantial part of the radiation between 380 and 1400 nm to the light-sensitive retina at the back of the eye. While environmental exposure to UV radiation is known to contribute to the accelerated aging of the outer layers of the eye and the development of cataracts, the concern over improper viewing of the Sun during an eclipse is for the development of "eclipse blindness" or retinal burns.

Exposure of the retina to intense visible light causes damage to its light-sensitive rod and cone cells. The light triggers a series of complex chemical reactions within the cells which damages their ability to respond to a visual stimulus, and in extreme cases, can destroy them. The result is a loss of visual function which may be either temporary or permanent, depending on the severity of the damage. When a person looks repeatedly or for a long time at the Sun without proper protection for the eyes, this photochemical retinal damage may be accompanied by a thermal injury - the high level of visible and near-infrared radiation causes heating that literally cooks the exposed tissue. This thermal injury or photocoagulation destroys the rods and cones, creating a small blind area. The danger to vision is significant because photic retinal injuries occur without any feeling of pain (there are no pain receptors in the retina), and the visual effects do not occur for at least several hours after the damage is done [Pitts, 1993].

The Challenge

Well, no one wants to purposely cook their retinas. So we wanted to check the glasses that we purchased. The American Astronomical Society (AAS) website had some advice on verifying eclipse glasses, saying



"Unfortunately, you can't check whether a filter meets the ISO standard yourself — doing so requires a specialized and expensive piece of laboratory equipment called a spectrophotometer that shines intense UV, visible, and IR light through the filter and measures how much gets through at each wavelength."

The Solution

Guided Wave manufactures both UV/Vis and Near Infrared (NIR) spectrophotometers that can measure film transmission over the range of 200nm up to 2100nm. We also had some solar eclipse glasses from a verified vendor that we used during the 2012 transit of Venus.

The Experiment

This sounded like a perfect experiment to us! Both the original (verified) eclipse glasses and the new (unverified) eclipse glasses were scanned for a comparison. The optical density (OD) of the lenses was recorded from 200nm to 2100nm covering the UV, Visible (508plus analyzer), and the NIR regions (NIR-O analyzer). The results are shown in Graph I with the red and green trace showing the verified lenses and the blue and purple trace showing the unverified lenses. Note that the OD scale is logarithmic. Converting this to %transmittance is shown in Table I.

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Table 1

OPTICAL DENSITY (OD)	% TRANSMITTANCE
1	10
2	1
3	0.1
4	0.01

Graph I

Results show the unverified or newly purchased glasses are suspected forgeries even though they were printed with ISO certification numbers, logo and name of an approved vendor. In the UV range the blue line represents a degradation in the quality and the same can be said in the NIR range (purple line).

The Conclusion

The lenses in the verified eclipse glasses provide excellent eye protection in both the UV and the NIR region. In the NIR the amount of light reaching your eyes is somewhere between 0.01% and 0.001%. The unverified lenses are much more transparent in the NIR region. At 1400nm the unverified lenses are transmitting about 1% of the light. While this is still a small number, it isn't worth the risk to your retinas. Amazon made the right call!

Control You Can Measure

Guided Wave has specialized in proven NIR, UV and Vis spectroscopic techniques for over 35 years. By partnering with Guided Wave customers gain the advantage of our expert staff of spectroscopists, engineers, chemists, chemometricians, technicians and certified global distributors.

