



ULTRAVIOLET RADIATION HAZARD

By GUY FORD BYARS, 1333 Cryer Ave., Cincinnati, OH 45208

About the Author

Guy Ford Byars was born in April 1958. At the age of 15, he and his father began restoring a J-3 Cub. Guy received his primary instruction in the Cub and soloed it at age 17. Since then, as school and work permitted, he earned his Private airplane, glider and Instrument ratings. He currently owns a Cessna 182 Skylane and a high performance glider (LS-4) and flies a Pawnee tow plane once a month at the Caesar Creek Soaring Club in Waynesville, OH. He is employed by the Structural Dynamics Research Corporation in Cincinnati as an engineer.

His interest in ultraviolet (UV) research is one of necessity. He was born with a very rare disease called Erythropoietic Protoporphyrria. One of the effects of this disease is a hypersensitivity to UV and visible light. So much so that exposure to direct sunlight for more than a few minutes will cause the exposed area to swell and experience severe pain for days. Having the desire to fly a glider like a normal person, he began to research this disease and UV light. He found which wavelengths of UV and visible light caused him problems. Then, with the use of a spectrophotometer at the University of Cincinnati, he analyzed countless films and dyes to find which ones filtered out those wavelengths. He found a suitable film and installed it on the inside of his glider canopy. He overcame his handicap and can now fly gliders as long as a normal person.

The more he researched UV light, the more he became aware of how bad it is for "normal" people. Also, having friends and family experience skin cancer surgery, he felt it important to use his knowledge and experience on the subject to inform the public, and pilots in particular, of the dangers of UV exposure.

Exposure to ultraviolet radiation (UV) generated by the sun poses serious health risks. We as pilots can be exposed to a great deal of UV throughout our lives. This article will detail what UV is, why it is particularly bad for pilots, and what we can do to reduce our exposure to it.

What Is UV And Why It Is Harmful

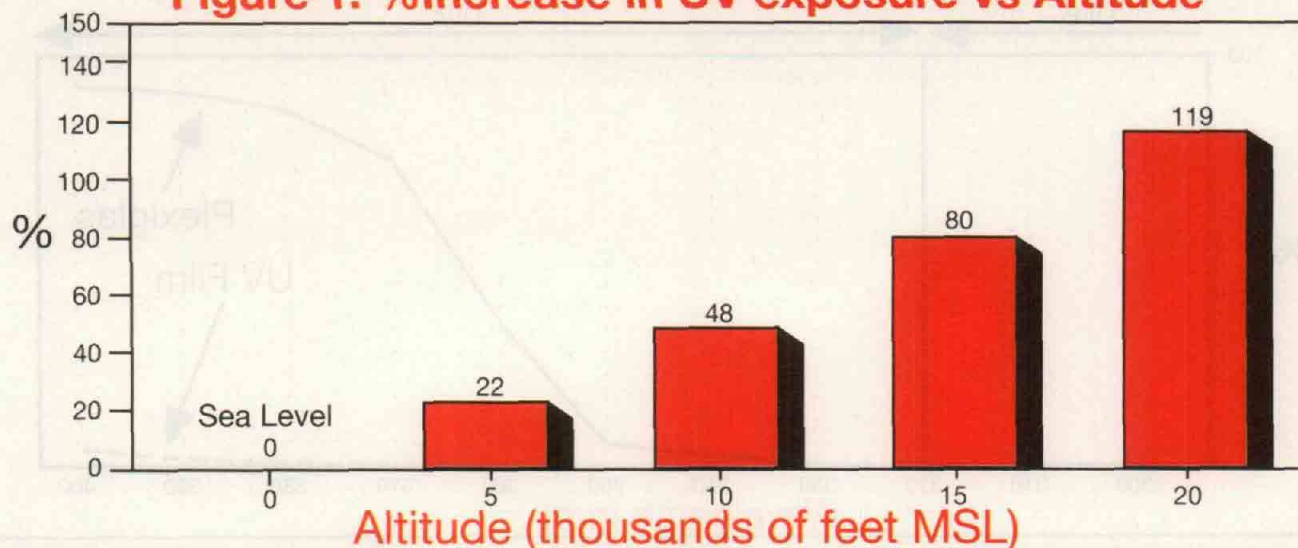
The sun emits a wide spectrum of electromagnetic radiation, including infrared, visible, and ultraviolet. Based on its wavelength in nano-meters (nm), the UV reaching the earth can be categorized into ultraviolet A (UVA; 320nm-400nm) and ultraviolet B (UVB; 290nm-320nm). The intensity of UVA or UVB reaching the earth is subject to numerous variables, including time of day, altitude above sea level, scattering by atmospheric substances, etc. Depending on these variables, UVA exposure can exceed that of UVB by 10 to 1,000 fold. During the early morning and late afternoon, UVB irradiance is comparatively small, whereas significant UVA levels may be encountered throughout the day.

UV poses very serious health risks. There is extensive medical evidence that UV causes several forms of skin cancer. Both Basal cell carcinomas, the most common skin cancer, and Squamous cell carcinoma, a more dangerous form of skin cancer, are directly related to long term UV radiation exposure.

UVA and UVB are quite different, yet both are damaging. UVB is the primary cause of both sunburn and skin cancer. UVA plays a role in skin cancer because it increases the carcinogenic effects of UVB. While UVA doesn't cause sunburn as quickly as UVB, UVA penetrates deeper into the skin causing a much more damaging burn. UVA also contributes to a wide variety of other medical problems including blood vessel and DNA damage. UVA has been consistently linked to skin changes associated with aging, such as skin wrinkling and sagging.

Skin cancer, in which UV exposure plays an important role, is the most common form of cancer. Unfortunately, the number of cases of skin cancer has increased more than 50% in the past decade. More important to us is the increasing number of pilots who, after 30+ years in aviation, are now having repeated surgery for removal of facial skin cancers. There-

Figure 1. %Increase in UV exposure vs Altitude



fore, it is imperative for everyone, especially pilots, to consider ways to minimize exposure to UV.

Pilots Have High UV Exposure

By the very nature of aviation, pilots are exposed to a great deal of sunlight. In order to fly, we must be outdoors. Also, we in sport aviation usually fly when the weather is nice and sunny and stay outside at fly-ins from early in the morning until dusk.

To make matters worse, many homebuilders and sport pilots use bubble canopies which expose them to a lot of sun but provide no protection against it. Since there is less atmosphere to screen the sun at higher altitudes, the damaging effects of the sun are compounded by 4% for each 1000 ft. above sea level (Figure 1).

Given that in order for us to pursue aviation we expose ourselves to a great deal of sunlight, what can we do to reduce our health risk from UV? There are many effective ways. Sunscreens, clothing, sunglasses, and UV filtering films all are effective in reducing UV exposure. I will discuss each one and try to clear up some common misunderstandings.

Sunscreens

The single most important thing to remember about sunscreens is to **USE THEM!** You must follow the instructions provided with the sunscreen and reapply them as directed. Sunscreens cannot protect you unless you use them!

The effectiveness of sunscreens is usually rated by a sun protection factor (SPF). This gives an indication of how many times your natural sunburn protection the sunscreen will provide. It is easy to misinterpret these SPF factors. A sunscreen with SPF 15 will

block 93% of UVB while one with SPF 50 will block only 5% more. Also, the SPF is only an indication of the protection against the UVB. It gives no information whatsoever about the sunscreen's ability to protect against UVA. Indeed, the majority of sunscreens available today, even those with SPF factors as high as 45, provide little or no protection in the UVA wavelengths. High SPF sunscreens without UVA protection can be dangerous. They prevent sunburn which allow people to stay out in the sun longer, thus exposing themselves to large amounts of UVA.

Several sunscreen products have been recently introduced which effectively block both UVA and UVB. The most effective is a brand called PHOTOPLEX (available at pharmacies). This isn't the only one which is effective against UVA. Many new products are being introduced. Be aware that while most sunscreens will advertise that both UVB and UVA are blocked, a sunscreen need only block as little as 1% of the UVA in order to claim UVA protection. The effective UVA sunscreens can be identified by the term "Broad Spectrum," or by a separate UVA screen factor.

Hats

Over 70% of the hats sold in this country last year were the common "baseball" type. This is unfortunate because the baseball hat does not provide adequate protection from UV. This is a very important point that we all need to be aware of. While the baseball hat does cover your head (essential for those with thin hair), forehead and nose, it provides no protection for your ears, neck and cheeks. One of the most common places for skin cancer to occur is on the cheek, a place which the baseball

hat does not cover. Instead of the baseball hat, you should wear a broad brimmed hat. Both cowboy hats and pith helmets are hard to beat.

Sunglasses

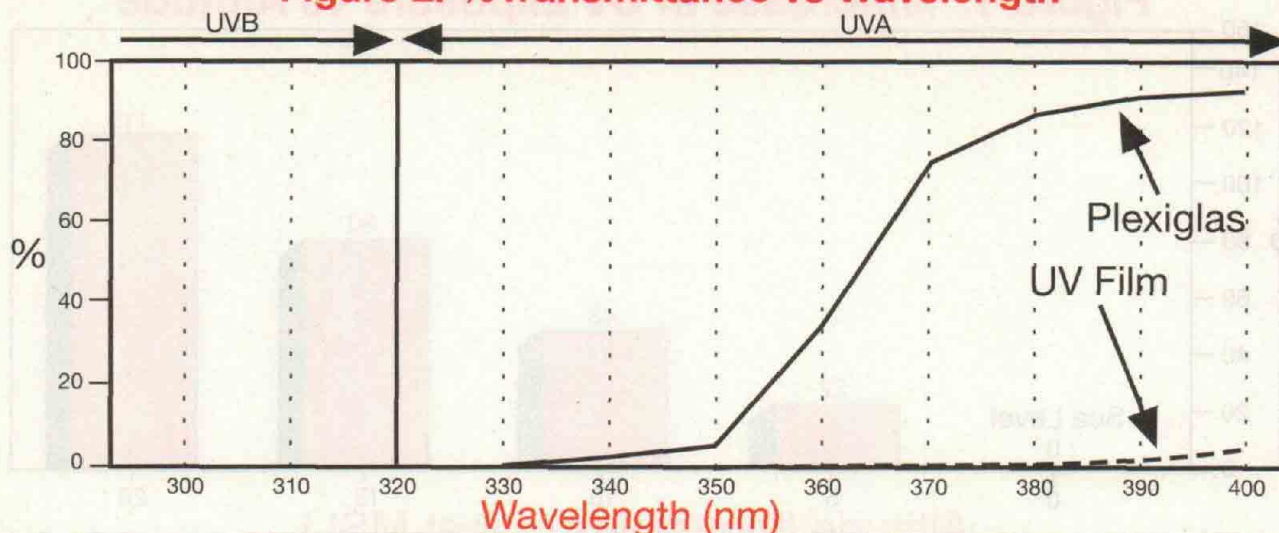
Not only does your skin suffer from the effects of UV, but your eyes do too. Eye damage, caused by UV, can easily be prevented by the use of high quality sunglasses. Most all sunglasses are now sold with information about their UV blocking abilities. High quality sunglasses will state that both UVB and UVA up to 400nm are filtered. Avoid cheap sunglasses which just claim to "Block UV rays." They may only block a small amount of UVB, yet still allow significant UVB and UVA to enter.

Automotive Glass

We receive a great deal of UV exposure through the driver's window of our cars. This is clearly demonstrated by the fact that drivers in countries with left hand drive cars have a higher incident of skin cancer on the left side of their faces. While drivers in countries with right hand drive cars have a higher incidence on the right side of their face. Therefore, it is important to do all we can to reduce UV exposure while driving.

Automotive glass very effectively blocks UVB, but not UVA. Therefore, while you might not get sunburned through glass, the cancer causing UVA still comes through. The easiest way to prevent this is to apply a UV protection film to the driver's side window of your car. You can install this film yourself, or have an auto customization shop do it. It is not necessary to apply a "smoked" or tinted film in order to obtain UV protection; there are clear films available

Figure 2. % Transmittance vs Wavelength



which will do this quite well. I highly recommend a clear film made by the Madico company sold under the name CLS-200-X. Since it is clear, you won't be able to tell it is on the window, but it still provides 100% protection against both UVA and UVB. This will also help prevent your car's interior from deteriorating. The film can be purchased from Madico, 64 Industrial Parkway, Woburn, MA 01888, 800/225-1926, 617/935-7850.

Plexiglass Canopies

A common misconception about plexiglass canopies is that they will adequately protect you from the sun. They don't. Plexiglass will only provide protection in the UVB wavelengths. Thus, while you might not sunburn as badly through plexiglass, you are still exposed to UVA. As with sunscreens, since the UVB burning wavelengths are blocked, one might stay out in the sun longer, thus being exposed to a great deal of UVA. While the blue tinted canopies look nice and might help you feel cooler, they provide no additional UV filtering.

Applying Films To Plexiglass Canopies

I have been researching the use of films applied to canopies to protect the pilot from UV. Again, the Madico CLS-200-X can be used for this purpose. Figure 2 shows how the UV filter compares with clear plexiglass. While the graph does show that plexiglass provides protection to UVB and some UVA, it still allows significant UVA to be transmitted. This UVA exposure is especially bad for pilots because it increases with altitude.

Let me describe some of the limitations of applying film to plexiglass. Most UV films were designed to be

applied to flat window glass. They come with a pressure sensitive adhesive on one side which is used to bond them to the window glass. The film can be applied to flat plexiglass and to plexiglass curved in a single direction, a cylinder for example. However, these films are not pliable enough to be applied to canopies with compound curves. Therefore, their use on canopies is limited. However, if your aircraft has flat side windows, like the Piper Pawnee, for example, then you might consider it.

One important note about plexiglass. According to the manufacturers, plexiglass will produce gasses as it ages. If a film is bonded to it, then those gasses can become trapped between the film and plexiglass, causing bubbles to form. However, I have several test specimens of film bonded to plexiglass which are over two years old and have not shown this problem. If you do try this, then do some testing yourself first and make sure you can easily replace any plexiglass panels if they show signs of bubbling.

Plexiglass Dyes

In my opinion, applying film to plexiglass is not the ultimate solution. The best long term solution is to have the manufacturer dye the plexiglass while it is being made. I have done some experiments using clear dyes which were made for the eyeglass industry to block UV in glasses. They showed that plexiglass can be dyed to filter out all UV and still remain clear. These experiments were limited because the dyes are very expensive and the plexiglass must be heated to over 180 degrees F for the dye to be absorbed. At these temperatures plexiglass becomes soft and a canopy which has already been formed could easily be ruined.

While dying plexiglass is not feasible for the individual, it would seem like an easy process while it is being manufactured. It is up to us to inform the plexiglass manufacturers that canopies with UV protection is a serious concern. Given the information we now have on the damaging effect of UV, we must make the manufacturers aware of the necessity of such canopies.

Recommendations

In summary, the following four measures will help reduce your UV exposure:

1. Always use a sunscreen. Do not be misled by high SPF numbers. Only sunscreens which state that they are BROAD SPECTRUM provide protection throughout the entire UV spectrum. PHOTOPLEX is the most effective sunscreen in the UVA wave lengths available today.
2. Wear as much clothing as practical. Always wear a large hat outside the cockpit and at least a tennis hat while flying. Throw those baseball hats away and get a hat that will provide protection for your entire head and neck.

3. Have a clear UV film applied to the windows of your car. This is relatively inexpensive, but will reduce UV exposure while driving.

4. Inform the canopy manufacturers and plexiglass suppliers that a canopy with complete UV protection is important to you. If you would be willing to pay extra for such a product, then certainly make that point known.

It is imperative that we protect ourselves from UV on a daily basis throughout our lives. By starting now, one stands a good chance of avoiding the skin cancer surgery that many long time pilots are now requiring. ♦