
ULTRAVIOLET DEGRADATION OF AIRCRAFT COVERINGS

1 Introduction

Unpainted sails / covers, such as those fitted to weight-shift control and 'rag-and-tube' 3-axis control microlights, are degraded by exposure to sunlight. This degradation is due to ultraviolet (UV) radiation, which is present in large quantities in sunlight. The UV radiation can affect the fabric¹ and the stitching².

Affected microlight types are subject to residual strength testing as part of the annual inspection for revalidation of their Permits to Fly. Testing was introduced in around 1993, almost a decade after microlights were regulated, following concern that aircraft were continuing to be flown after their sails / covers had degraded to such an extent that they were no longer safe. This testing usually takes the form of the Betts test.

The BMAA are concerned that sails / covers are sometimes failing the Betts (or similar) test after only a very few years. The sails / covers involved are therefore losing a significant amount of strength each year. This leads to the possibility that a sail / cover may degrade to such an extent that it becomes unsafe between annual tests.

<p style="text-align: center;">WARNING A SUCCESSFUL PERMIT TO FLY REVALIDATION INSPECTION DOES <i>NOT</i> GUARANTEE THAT THE SAIL / COVERS WILL REMAIN AIRWORTHY FOR THE NEXT 12 MONTHS!</p>

This document advises owners of how to store and operate their aircraft to minimise sail / cover degradation due to UV radiation. It also advises owners when to consider performing additional Betts (or similar) testing between Permit to Fly revalidation inspections.

2 Aircraft storage

All aircraft are stored for many more hours than they are flown, so UV radiation exposure when being stored can be critical.

2.1 Direct sunlight

Direct sunlight has a high UV radiation content. Therefore whenever possible aircraft that are affected by UV radiation should be stored out of direct sunlight.

2.2 Scattered sunlight

UV radiation is scattered by clouds³. Therefore an aircraft stored out of direct sunlight, but with a view of the sky, can still be exposed to significant quantities of UV radiation.

For example: an aircraft stored in an open, north-facing barn, might still be exposed to degrading quantities of UV radiation, even though it is always in the shade. The wing nearest the opening will likely degrade faster than the wing in the gloomy rear of the barn.

2.3 Reflected and filtered sunlight

UV radiation is reflected by surfaces. The amount reflected is very dependent on the actual surface ranging from less than 2% for grass through 12% for concrete to over 80% for snow³. Therefore an aircraft stored in an enclosed building, but that is bright due to reflected sunlight, might still be exposed to significant quantities of UV radiation.

Typical window glass blocks a certain amount of UV radiation. The exact proportion depends on the type of glass and the wavelength of the UV radiation⁴. Therefore an aircraft that receives direct (or scattered!) sunlight through glass skylights might still be exposed to significant quantities of UV radiation.

2.4 Conclusions

It is clear that an aircraft stored outside (in direct sunlight) or an open building (in scattered sunlight) will be exposed to significant quantities of UV radiation. It is also clear that an aircraft stored in a dark, enclosed hangar will not. The exact amount of UV radiation in a bright, enclosed hangar – where the sunlight entering has been reflected and filtered – is not easy to determine without taking measurements. If in doubt, assume that the aircraft is being exposed to UV radiation until experience tells otherwise.

¹ And the high-strength reinforcement used in high-performance, weight-shift control, aircraft sails.

² Many modern sails / covers are stitched with PTFE thread, which is largely UV-stable.

³ Parisi, A. V., Sabburg, J., & Kimlin, M. G. (2004). Scattered and Filtered Solar UV Measurements. Dordrecht (NL): Kluwer Academic Publishers.

⁴ Praezisions Glas & Optik GmbH (www.pgo-online.com) product transmission curves.

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3 Aircraft operation

However carefully an aircraft is stored, it will still be exposed to UV radiation when it is outside. The UV radiation content of the sunlight will (primarily⁵) depend on:

- The weather conditions. See sections 2.1 and 2.2.
- The time of day. More UV radiation during the middle of the day than early or late.
- The time of year. More UV radiation during spring and summer than autumn and winter.

Most aircraft are parked outside for at least as long as they are flown. Therefore, parking the aircraft in the shade whenever possible may result in a worthwhile reduction in UV radiation exposure and a useful increase in sail / cover life.

3.1 Sunscreen

Products are available for fabric that act in a similar way to sunscreen for skin. Use of these may result in a useful increase in sail / cover life. There is always the concern that if the product is incompatible with the fabric it may accelerate degradation however. Therefore always consult the aircraft manufacturer before using.

3.2 Covers

Opaque covers can be used to reduce UV radiation exposure while an aircraft is being stored. Covers must be well fitting without top-surface gaps. A degraded area, however small, will render the whole sail / cover unairworthy. Loose fitting covers used outside can cause abrasion damage.

3.3 Cleaning

It is recommended to clean an aircraft's sails / covers with just water if possible⁶. Using a detergent, or other chemical, may accelerate degradation, so always consult the aircraft manufacturer first. If using a detergent, ensure that it is mild and used as dilute as possible. Rinse well to remove all residue afterwards.

4 Mid-year testing

If an aircraft's sails / covers pass the Betts (or similar) test then they will be strong enough not to fail in flight. Also, the Betts test load will have been chosen with a reasonable safety margin⁷, which permits some further degradation before the sails / covers become unsafe. However that safety margin is not large enough to guarantee a year's safe flying irrespective of how the aircraft is operated⁸. Previous to this document there has been little advice for owners on what is a safe year's operation, and at which point mid-year testing should be considered.

Given that hours flown is such a crude measure of UV radiation exposure (see section 3), and different fabrics degrade at different rates, it is difficult to provide generic advice for owners. However, in consultation with the UK's microlight manufacturers and importers, the BMAA provide the following basic advice to owners to assist them in keeping their aircraft airworthy:

RECOMMENDATION
(IN LIEU OF ADVICE TO THE CONTRARY FROM THE AIRCRAFT MANUFACTURER)
OWNERS OF AFFECTED AIRCRAFT THAT FLY MORE THAN 100 HOURS PER YEAR
SHOULD CONSIDER HAVING THEIR SAILS / COVERS TESTED EVERY 100 FLIGHT HOURS
BETWEEN PERMIT TO FLY REVALIDATION INSPECTIONS

Important notes:

- This recommendation assumes careful storage and operation. If the aircraft is exposed to significant quantities of UV radiation when it is being stored, or the aircraft is parked outside for extended periods, flight hours might not be an appropriate measure and a testing schedule based on calendar time might be more appropriate. Consult the aircraft manufacturer.
- Some fabrics (and thread) used on microlights are degraded by UV radiation more than others. This makes it difficult to write generic advice. The recommendation above assumes traditional, woven, polyester sailcloth (Dacron), which is normally the least UV-stable of the fabrics generally used on microlights. Particular fabrics may be significantly more UV-stable than Dacron. Consult the aircraft manufacturer.

⁵ The UV radiation content of sunlight is also dependent on altitude, longitude, airborne aerosols, the condition of the ozone layer, etc.

⁶ Use of a pressure washer at too high a pressure can also cause damage.

⁷ The safety margin is agreed between the manufacturer and certifying agency during the approval process.

⁸ In fact it is impossible to choose a safety margin that is large enough to guarantee a year's safe flying as some fabrics are known to deteriorate from new to unairworthy in significantly less than a year's exposure to direct sunlight.