SERVICE BULLETIN
Title: Sail Life Extension and Condition Monitoring

Identification	SB-007
Status	Active
Issue	1
Issue Date	17 March 2008
Applicability	Airborne Microlight Wings up to 450kg Maximum Take Off Weight. Edge, Wizard, Streak Series, Cruze, Merlin Wings
Compliance	Optional

Issued by: Scott Barrett, Airborne Windsports
Approved by: The technical content of this service bulletin has been approved by CASA.

Summary of Changes: First issue

1. Introduction

The principle action of this service bulletin is to define accurate limitations for the end of service life for the sail based on condition monitoring of the structural strength of the sail.

Through operational experience, it has been observed that many wings approach replacement interval in good airworthy condition, potentially with many more safe flying hours remaining on them. This service bulletin offers optional life extension on Edge sails, according to continuing condition monitoring of the structural integrity of the sail. Sail care information is provided for the Wizard, Streak Series, Cruze & Merlin Sails where maintenance manual information determines the end of life of these sails.

Ultimately, a sails life is determined by how it used and cared for. Condition monitoring of the sail verifies airworthiness of the sail, accounting for variables such as wing storage conditions and maintenance practices. This service bulletin provides quantitative structural performance measurements of the sail to determine the airworthiness of the sail, independent of the aircraft operating hours. Condition monitoring and return to service after abnormal storage conditions is discussed for all sails to which this document is applicable.

This service bulletin provides information related to the care of the sail, including maintenance practices and common degradation mechanisms.

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2. Table of Contents

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3. Action

Comply with inspection procedures to apply the optional life extension.

Sail care notes are provided; an operator may use this to conduct preventative maintenance in a manner that best extends the operational life of the sail.

4. Skills

The pilot and maintainer may make use of the information provided to incorporate this service bulletin as standard practice.

5. Weight and Balance

No change.

6. Documentation

No checklist or compliance notes are provided with this service bulletin. It shall be recorded in the aircraft maintenance log when inspections are performed, a note shall be made when returning a wing to service as a part of a life extension inspection program,

7. Inspection Requirements

What is Bettsometer Testing?

Bettsometer testing is a method of determining the tensile strength of the sail fabric and stitching, which is known to degrade during the life of the sail.

Hour or Time Related Check Requirements

Annual sail inspection is recommended. As well as the annual inspection, there are several criteria for testing of sails, which are highly dependent on the conditions that the sail fabric is exposed to. The pilot/operator of the aircraft is responsible for determining the level of exposure that the sail experiences.

Generally the method used for fabric testing is a Bettsometer test (on an annual basis). Annual testing has been found to be adequate for recreational user where the operator takes care to avoid unnecessary exposure to UV.

More frequent testing (every 100 operating hours, 200 UV hours) is applied to life-extended sails.

7.2.1 Specific Inspections for Edge Sails

- **Edge Sails with a Total Time In Service (TTIS) <= 400 Hours:**
    - Perform sail inspections on Edge wings as recommended in accordance with this Service Bulletin.
    - Care of the Edge sail as recommended in accordance with this Service Bulletin.

  Where aircraft have been exposed to high levels of UV over an extended period (such as being left set-up in the open for 3 months or more - equivalent to 750 UV hours), then testing prior to return to service is required.
    - Perform Bettsometer test and a Visual Sail Inspection in accordance with this Service Bulletin.

- **Edge Sails with a Total Time In Service (TTIS) > 400 Hours:**

  Note: If a wing is flown, and or left in the open for a day, this will equate to 8-10 hours of UV exposure. If a wing is stored under a roof, but the roof does not have doors on the front – i.e. an open hanger, the wing will still experience UV degradation.

  - Every 100 Hours Time in Service (TIS), 200 UV hours or 12 months (whichever occurs first):
    - Perform Bettsometer test and a Visual Sail Inspection in accordance with this Service Bulletin.
    - Care of the sail is to be in accordance with this Service Bulletin.

- **Edge Wing Return To Service After Long Storage (greater than 12 months):**
  - Perform Bettsometer test and a Visual Sail Inspection in accordance with this Service Bulletin.

7.2.2 Specific Inspections for Streak, Cruze and Merlin Sails

- **For all Streak, Cruze and Merlin sails:**
  - Perform sail inspections on Streak, Cruze, Merlin wings in accordance with the wing Maintenance Manual.
  - Care of the sail is to be in accordance with the wing Maintenance Manual,
  - Additional information from this Service Bulletin may be optionally applied.

- **Streak, Cruze and Merlin Sails, Return To Service After Long Storage (greater than 12 months) or Abnormal Storage:**

  Where aircraft have missed an annual inspection due to being out of service, where aircraft have been exposed to high levels of UV over an extended period (such as being left set-up in the open for 3 months or more - equivalent to 750 UV hours):
  - Perform Bettsometer test and a Visual Sail Inspection in accordance with this Service Bulletin.

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8 Performing Bettsometer Testing

Bettsometer test is carried out with a 1.2mm diameter needle, with wing sails fitted and tensioned for flight.

Test requirements are:

- With the wing assembled, test the wing fabric and stitching in the approximate locations as indicated in the figure 2. Both the upper surface woven cloth and the stitching are to be tested on left and right wings.

Applied Test Loads:

- Upper & lower surface: 1360 grams.
- Stitches: 1360 grams using a 1mm or 1.2mm diameter hook, pull upwards.

The instructions that are supplied with the Bettsometer should be followed to ensure proper testing.

NOTE
Some instructions that may be helpful:

- The instructions that come with the Bettsometer recommend that *"any flat section of the sail, clear of obstructions"* is suitable for fabric testing. Single layer sections of the sail would give a more relevant test result than patched or multi-layered sections and those areas most exposed to UV damage (usually the top surface) would be the most useful to test.

- Likewise the stitching exposed on the top surface would show the most UV degradation and will give a better indication of the strength left in the thread than that on the under surface. Select a piece of non-critical stitching for testing such as part way along a batten pocket.

Figure 1 Bettsometer Instrument

An example supplier of Bettsometers is: http://www.conairsports.co.uk/

AirBorne supply Bettsometers for:

To purchase a unit from AirBorne, order BETTSOMETER UNIT Part #109095

8.1 Technique to Test Woven Cloth

The instructions that are supplied with the Bettsometer should be followed to ensure proper testing.

- Locate the approximate test area (refer to diagram of approximate test locations).
- Push the Bettsometer needle into the sail fabric until the needle is fully within the sail.
- Pull the Bettsometer by the spring slider, in the plane of the fabric in a chordwise and or spanwise direction (in the direction of the warp/weft of the fabric weaving), pull to the specified loading.
- The sample area passes the test when there is no tearing of the fabric.
- Test the woven cloth on both sides of the wing.

Only single layer sections of the sail cloth are tested, in areas without double layers, or repair patching. The leading edge is of multi layer construction. Leading cloth or leading edge laminate is not tested on any of the wing models.

8.2 Technique to Test Sail Stitching

- Locate the test area, using a secondary structure seam such as a batten pocket seam.
- Use the hook needle to hook under a single zig zag stich.
- Pull the Bettsometer by the spring slider, normal to the plane of the fabric (away from the sail), pull to the specified loading.
- The test passes when the stitch thread withstands the required load without breaking.
- Test the stitching on both sides of the wing.

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8.2.1 Map of Test Locations

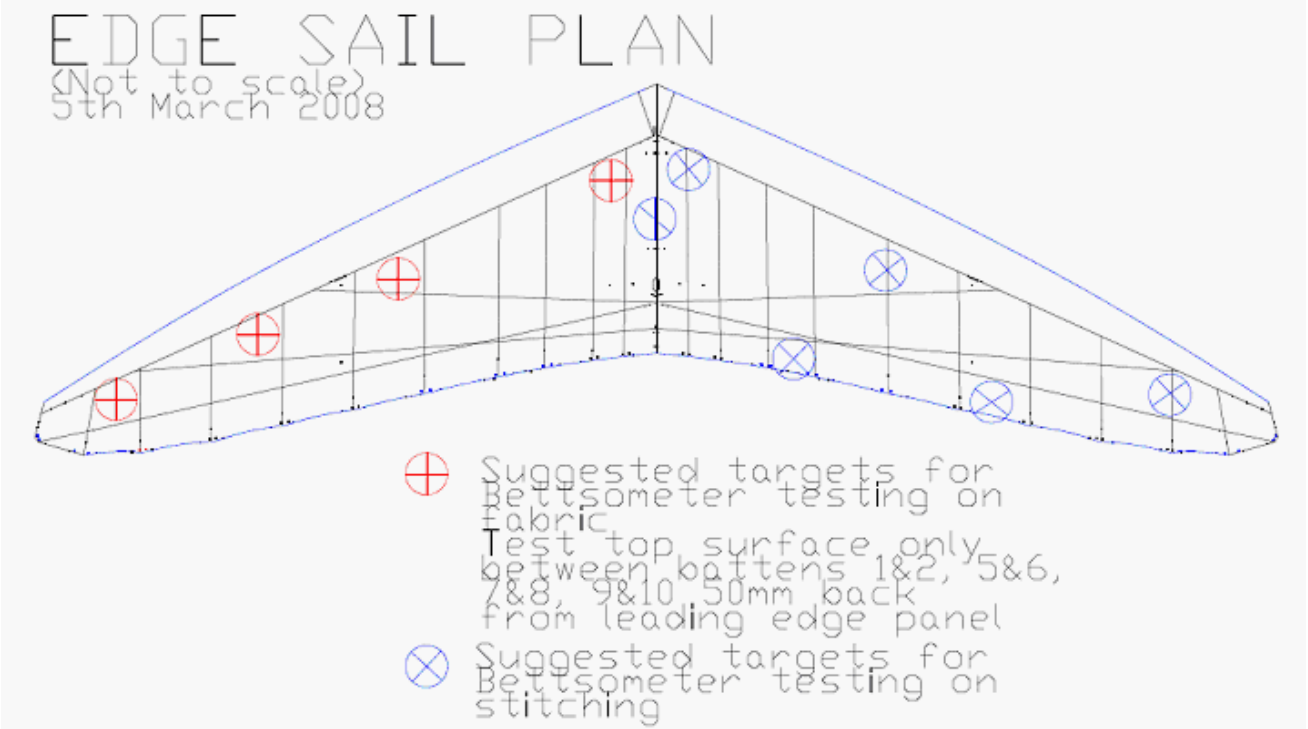

Figure 2

Conduct testing of woven cloth and stitching on both sides of the wing.

8.2.2 Limitations, Pass / Fail Criteria

	Loading			
Wing	**Top surface Warp**	**Top surface Waft**	**Stitching**	**Under surface**
Edge	1360g	1360g	1360g	Not tested
Wizard	1360g	1360g	1360g	Not tested
Streak	1360g	1360g	1360g	Not tested
Cruze	1360g	1360g	1360g	Not tested

The sample area passes the test when there is no tearing of the fabric or breakage of the stitching.
A failed test requires the sail to be removed from service.

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9 Visual Sail Inspection

Conduct a visual inspection of the sail, the purpose is to find wear points and areas requiring repair.

List of places to visually inspect for general condition abrasion etc:

- Wing tips, tip webbing.
- Crossbar junction, wire exit points top and bottom surface. Abrasion from internal frame components.
- Under surface (pack up / transport abrasion against hard points)
- General wire abrasion on open surfaces of the sail (pack up abrasion)
- Leading edge for chafing and delamination
- Check for tears in the sailcloth or any loose or unravelled seams.
- Check all webbing securing points are not damaged or worn. Tip webbing anchors are of particular importance.
- Check all inspection zippers to see if they function smoothly and close completely.
- Check for loose trailing edge sections that may have developed flutter.

10 Sail Care

Common degradation mechanisms on sails include the following:

- UV light
- Chemical:
    - Alkaline (including soaps, bleaches)
    - Strong Acids
    - Solvents (such as petrochemicals)
- Abrasion
- Fatigue
- Heat

10.1 Ultraviolet Light

Ultraviolet radiation from sunlight ultimately reduces the strength of Dacron, but the rate of damage may be reduced to an acceptable level by careful consideration of the wings use and exposure. In its bag the wing has greater protection than out. However wing bags are a loose weave and are not fully UV protective. Keep the wing fully protected from UV light degradation by keeping it in a dark place. Sunlight will eventually cause a sail to fail the required Bettsometer tests.

10.2 Chemical

Dacron is a stable material that is tolerant to a majority of chemicals, including alkalis, acids and solvents. Some of the chemicals to avoid on the sail include petrochemical solvents strong acids, and alkalis (such as bleach).

Advice given in this bulletin includes allowance for use of alkali soaps, weak acids and solvents, in these cases the cleaning agents are used where necessary, used in mild concentrations and the sail rinsed of the cleaning agent.

10.3 Abrasion

Abrasion of the sail is caused by contact of the sail with other objects while in use, while hangared and most particularly while the wing is being transported in its folded position. The correct location of padding, wires and components stored in the wing bag is important to reduce chafing during transport.

Typical abrasion points are listed in the inspection point list. Repair limits and methods are listed in the repair section of this document.

Dirt is a penetrating solid that has the ability to chafe the sail from the inside. Dirt and some other solid pollutants are prone to retaining moisture and assisting the growth of mildew.

10.4 Fatigue

Sail fatigue occurs infrequently. Slack trailing edge tension allows the trailing edge of the sail to vibrate / flutter in the unsupported region between the battens. This causes loss of the resin in the cloth and may eventually lead to failure of the cloth or a stitch line. Tensioning the trailing edge is performed by tightening the tip strut, tightening the rubber shock chord (batten tensioning system), or by tightening the screw tip battens. Alternately returning the sail to Airborne, the sail trailing edge may be tensioned by reworking the sail in the sail loft.

Sail trailing edge tension may be degraded rapidly by allowing a flutter to occur and continue operation. It is best to fix flutters earlier rather than later.

Always transport the wing within its cover bag. Do not transport a folded wing on a vehicle without its cover bag even for short distances.

10.5 Heat

Exposure to heat ages a sail by increasing its rate of shrinkage. In general, sails shrink over their lifetime with exposure to their regular operating environment. More extreme artificial sources of heat may cause significant dimensional changes that affect the handling properties of the wing.

10.6 Biological

Mildew is evident as black spots on a sail. This is harmless to the sail structure Mildew grows in wet sails put into storage. UV light kills mildew spores, so flying assists with preventing mildew. Dry the wing before putting it into a dry storage place.

Rodents have been known to cause damage to sails in long term storage, usually because microlight wings are stored dry and make a nice place for a rodent nest. A clean environment and occasional inspection of the security of the cover bag will assist with mitigating risks from rodents.

11 Protection

- Keep the sail covered when not in use, keep it in the dark where possible.
- Avoid using petrochemical solvents and oil based water repellent compounds.
- Avoid the use of strong alkalis such as bleach and strong soaps.
- Dry the sail before storage, keep the sail dry when in storage.
- Keep the sail stored away from high temperature.
- Rinse thoroughly after using mild detergents.
- Avoid using brushes when cleaning over stitching.
- Of all of the methods of degradation through common use, the most prevalent reason for a sail to reach the end of its service life is by far the degradation of strength from exposure to ultraviolet light.

12 Washing Sails

Washing your sail is a good way to conduct a condition inspection. Keep in mind that to leave stains is often quite a good option for sail care. A stain will often do less damage than the damage than scrubbing it off will do.

Wash sails using ph neutral surfactant such as “Rinse Aid” (automatic dishwasher surfactant), or other surfactants such as ph neutral shampoo. Where surfactants are not available, it is common to use a mild alkali soap and follow the washing by flushing with copious amounts of water.

- To remove general soiling and oils, use Rinse Aid surfactant or similar.
- To remove more stubborn oils, use ethanol such as methylated spirits (or vodka / whisky etc).
- To remove blood (or other proteins) and minerals use lemon juice or commercially available citric acid cleaner.
- Having tried the above methods, to remove more stubborn mineral soiling, use weak nitric phosphoric acid mix, or weak hydrochloric acid (up to 5% by volume in water). Apply weak acids cold and limit the time exposure of the sail by flushing with water.

For general washing, surfactants will usually suffice, with use of alcohol or citric acid as spot cleaner.

The sail is tolerant to weak acids used for cleaning purposes (and later rinsed off). Be aware that the aluminium other metallic components of the airframe are not tolerant to acids. When using acids carefully separate the sail cleaning operation from the airframe.

13 Washing Process

Find an open area with access to water and with a clean draining surface.

- With the wing assembled, pre treat areas of heavy soil / staining with application of surfactant or alcohol.

- Allow this to stand for some minutes to break up the stain. Soak the sail with water removing loose dirt.

- Using a surfactant / detergent solution, scrub the non-stitched areas of the sail with a soft, plastic bristle brush.

- Beware of chafing the stitching when using a brush during the cleaning process. Use only rags over the top of stitching and scrub along the direction of the seams.

- Rinse the sail using a hose, first on the outside, then from within the double surface area. Rinsing the inside is best performed with battens removed and the wing without sail tension.

- Leave the wing assembled or partially assembled to dry.

- Make or have made minor repairs to the sail at this time, authority and ability to make repairs is defined in the sail repair section of this document.

It is optional to apply sail care products to delay the effects of sail degradation, such products include:

- Waterproofing UV inhibitor www.303products.com

- “Textile Proof”. Holmenkol’s (www.contendersailcloth.com)

14 Wing Storage

Be mindful of the degradation mechanisms as listed in the sail care section.

- Store the sail dry, in a dry place out of light and heat.
- When storing on a rack, two padded racks are sufficient to support the wing (three racks or more are best for vehicle transport).
- If the wing is hangared, a dark fully enclosed hangar will best extend the life of the sail. Open hangaring of the assembled wing will reduce the life expectancy of the sail and as such, the inspection intervals as applicable to properly stored aircraft do not apply.

Abnormal storage conditions include:

- Assembled wings continuously stored in open (non-dark) hangars,
- Sails that have been exposed to chemical attack for prolonged periods other than for washing purposes.
- Sails stored in the wing bag, where the wing bag is continuously exposed to direct sunlight.

For condition monitoring of abnormally stored wings, refer to the next section.

15 Continued Condition Monitoring of the Sail

For life extended sails, sail test intervals are to occur at the maximum of:

- 100 flying hours or
- 200 UV hours or
- Yearly, whichever occurs first.

Testing after a long out of service period is recommended to prove airworthiness by conducting the yearly inspection prior to the start of the return to operating period.

For abnormally stored aircraft within the nominal life period of the sail, it is recommended to perform sail test condition inspections after 750 UV exposure hours since last inspection, before returning such a wing into service.

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16 Sail Repair

Minor sail repairs are a Line Maintenance task, which Sport Pilots are suitable to perform unless local regulations prohibit owner maintenance for sails.

A repair is classified as minor if tears are less than 30mm long, provided that no free edges (such as the wing trailing edge) are broken and that the tear is isolated and not within 50mm of an existing seam line or 100mm of the trailing edge. Also, abraded holes no more than 15mm in diameter. Such damage may be replaced with self adhesive patch material (Often called “sail tape” or “sticky back sail repair tape”) such as used for registration letters. If possible a patch should be applied to both sides of the fabric.

(Reference BMAA TIL No. 015 Issue 1.)

The repair tape is available from AirBorne as a spare part, various colours are available:

DACRON STICKY BACK WHITE 100944
DACRON STICKY BACK BLACK 108067
DACRON STICKY BACK BLUE 108062
DACRON STICKY BACK GREEN 108064
DACRON STICKY BACK ORANGE FLURO 108065
DACRON STICKY BACK RED 108061

Surface abrasions made to the mylar coating on the leading edge may be repaired as above with sail tape. Alternately mylar covering is available from AirBorne as a spare part:

MYLAR STICKY SAIL REPAIR A4 Part number 109030.

Any other significant sail damage should be discussed with Airborne or an Airborne independent distributor for an assessment of the best repair option.

17 References

A STUDY OF THE EFFECTS OF CHEMICALS ON THE PROPERTIES OF PARACHUTE FABRICS
AD Number: AD0097243 *Corporate Author:* NORTH CAROLINA STATE UNIV AT RALEIGH SCHOOL OF TEXTILES *Personal Author:* TEMPLETON, J. G.
http://stinet.dtic.mil/cgi-bin/GetTRDoc?AD=0097243&Location=U2&doc=GetTRDoc.pdf

GUIDELINES FOR THE REPAIR OF MICROLIGHT AEROPLANE SAILS
British Microlight Aircraft Association
Technical Information Leaflet
NO:015 Issue:1 November 1998
http://www.bmaa.org/upload/techdocs/015_1.pdf

Streak 3 & Cruze Maintenance Manual and IPC
http://www.airborne.com.au/images/manuals/S3CZMMIPC2.pdf

http://www.sailingsource.com/neilpryde/faq.htm