**BGA Airworthiness and Maintenance Procedure**

# COMPOSITE STRUCTURE MAINTENANCE AND REPAIR (AMP 4-5)

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## INTRODUCTION

High performance sailplanes have exploited the use of composite materials in their structure since the late 1950s. When flown in competitions gliders of composite construction are often flown close to the flight envelope speed limits which demands that issues such as control balancing, structural integrity associated with aeroelasticity and flutter considerations are carefully monitored. There have been many instances of structural damage to composite sailplanes being discovered following abnormal incidents where there has been little or no external evidence of any structural defect. Particular care is therefore required in assessing damage in composite sailplanes which have been subjected to ground loops, in-flight `flutter', lightning strikes, excessive `G' or exceeding limiting speeds. A ground loop, for instance, can impose severe loads in a T tail, fin and rear fuselage. Inspection to determine the extent of damage must be carried out methodically and thoroughly.

Where repairs are required, the principal of repair is to restore the structure to the design standard. Repairs must be carried out in accordance with the techniques and limitations stated in the manufacturer's Maintenance and Repair Handbook. Where the damage exceeds the scope of repair as defined by the manufacturer then a repair scheme must be drawn up and approved by the manufacturer. Such a repair must be documented as a major modification.

If in doubt, always consult a qualified expert.

## INSPECTION TECHNIQUES

Composite structures are particularly vulnerable to impact shocks and even non-flying incidents such as items dropped onto surfaces should result in an inspection for softening or delamination. Apart from the usual visual methods of detecting damage, a defect can be traced in composite structures by getting an assistant to flex the tailplane, fin or wings whilst you listen to the structure with a stethoscope. Internal damage can produce creaking or squeaking of the structure which would otherwise be almost inaudible. A further test for sandwich structures is to tap the surface very lightly with a coin and listen for any change in note as the surface is traversed. Additionally, any bonding failure in a sandwich construction can often be detected by examining the surface obliquely under good lighting conditions. Distortion of the light lines can indicate a skin separation. Any bonding failure must be rectified.

The possibility of damage to metal parts within otherwise undamaged composite structures must also not be overlooked. The range of control movements should be checked. Root rib fittings and spigots, and their surrounding areas, must be carefully examined following any of the incidents listed above.

Possible damage to single skin structures, eg fuselages, can often be detected by cracking of the gel-coat or by comparison of skin stiffness under finger pressure (approx. 10 lbs. force) to a similar point on the other side of the structure. Examination of the internal structure using mirrors or introscopes may also aid defect investigation. Any soft spots or areas where there appears to be whitening of the general translucent green of the GRP must be thoroughly examined, as these are the classic signs of damage and will inevitably mean that repair action is required.

A further test of the integrity of wing structures may be made by supporting the fuselage at points defined in the manufacturers' manual and measuring the natural frequency of bending of each wing in turn. This is done by gently shaking one wing tip and recording the number of oscillations of the other wing tip per minute. Any change in natural frequency, particularly a decrease, from a

previously recorded figure (such as that recorded by the manufacturer in the delivery documentation) or a variation between wings of more than 5% should be investigated.

## REPAIR TECHNIQUES

Minor repairs to composite structures may be carried out following schemes defined in the manufacturer's handbook. Major repairs, affecting the structural integrity of the glider, must be carried out in accordance with a repair scheme approved by the manufacturer, must be supervised and certified by a BGA Senior Inspector and will almost certainly be subject to BGA Complex Maintenance requirements. The following precautions are necessary in addition to those appropriate to wood and metal repair:

a. Staged inspection of the whole repair process is essential. This applies to initial manufacture as well as repairs and is a means of process control which has to be more rigorous than is required for aircraft work in other materials because the operator is, in essence, creating the structural material and not merely fitting ready made material to the aircraft. Surface preparation, resin examples, lay and number of reinforcements must all be labelled and retained for subsequent inspection.

b. Minor repairs should only be attempted in a reasonably warm and dry environment; major repairs require a minimum temperature of 23°C and a maximum humidity of 75%.

c. It is essential that only the correct materials as instructed by the manufacturer are used and, in all cases, the direction of the lay of the cloth is very important. Polyester resins, and fibre materials treated for polyester resins as used in cars and boat repairs, are NOT compatible with the epoxy structure used in gliders and should never be used in structural repair work.

## HUSBANDRY OF COMPOSITE STRUCTURES

It is essential that destructible fluids such as battery acids and acidic hardeners (as used with Aerolite glue) do not come into contact with composites since they cause immediate and serious damage. It is also highly desirable to protect composite structures from unnecessary exposure to ultraviolet light (UV) and moisture, both of which cause insidious and long term deterioration of the structure. Composite materials are porous and soak up moisture to a certain extent, causing loss of strength between fibres and resin. UV also causes crazing of the resin. Gel-coat paints provide some protection against moisture but are themselves crazed by long term exposure to UV. Accordingly, maximum use should be made of wing covers, hangars and trailers for storage of gliders; water ballast must never be left in wings overnight.

Polyester gel-coats must be cleaned and repolished at regular intervals (at least every 6 months) using water, with minimal use of detergents, and non-silicone wax polish. For removal of marks and contamination, local cleaning using tar removers based on benzenes or alcohol may be used in small quantities. Use moderate wiping pressure and ensure the surface is carefully dried off and repolished. Paint thinners and solvents (trichloroethane and carbon tetrochloride (CTC)) should NEVER be used for cleaning purposes. They are especially damaging and will quickly delaminate the gel-coat surface.

End.