BGA AIRWORTHINESS AND MAINTENANCE PROCEDURES

PART 4, LEAFLET 4-7

MAINTENANCE AND REPAIR OF AIRCRAFT FLYING CONTROL CABLES

MAINTENANCE

1. The most common defects which are encountered in glider control cables are wear of the outer wires, causing `flats', eventually leading to breakage, caused by rubbing against fairleads, and fraying, caused by fatigue due to bending, at fairleads, rudder pedal adjusters, and control knobs. Because fatigue and wear affect numerous wires within the cable bundle, even one broken wire should require deeper investigation and should normally be cause for rejection. A cable is made up of several strands and each strand is made up of several wires. Hence; 7 x 19 means; 7 strands each made up of 19 wires. The diameter of the cable is measured over the outer wires at its maximum point. In some applications less flexible cables are used e.g. 7 x 7, only the correct type of cable must be used for each application and a different type may not be substituted without approval.

2. Full examination of glider control cables sometimes presents difficulties due to them being run through conduits and structure from which they cannot be removed. In these circumstances sample examination may be carried out on the accessible length of cable. However particular attention must be paid to points where the cable changes direction and these should always be examined. Control cables should not be lubricated unless it is a specific maintenance item issued by the aircraft manufacturer.

REPAIR

3. Ideally, unserviceable cables should be replaced by cables with pre-manufactured end fittings, ready proof tested, in accordance with general aircraft practice. However many glider control cables run through fairleads and conduits, making them difficult to remove and refit complete with their end fittings. For cables, which run through steel tube fairleads welded to the structure, an acceptable solution is to saw an axial slot in the tube, push out the fibre bushing and extract the cable through the slot. The steel fairlead may be subsequently nipped up, the bushing pushed back, and repaired with a fibreglass tape wrapping.

4. Alternatively, new cable end fittings may be swaged in situ using (for example) either `Talurit' or `Nicopress' swaging processes. `Talurit' swaging facilities are available at a number of service units in UK, `Nicopress' is a similar system of US origin but using a less expensive manual swaging tool or hand held tool using a spanner. Civil Aircraft Airworthiness and Inspection Procedures, Part 2, Leaflet 2-12 gives further information on cable splicing and swaging.

5. Only aircraft quality, `extra flexible' 7 x 19 cable is to be used for glider control circuits (including the release system). Either galvanised carbon steel cable to American Mil Spec MIL-W-83420 type A or British Standard BS-W9 or –W12, or corrosion resisting steel cable to American MIL-W-83420 type B or BS-W11or W13, may be used, which are approved alternatives for the DIN specification cables used on many European gliders. However to avoid corrosion problems, only use the correct combination of swages and cable types. The BGA do not recommend using Stainless Steel cable due to poor fatigue and rapid wear properties

a) **Talurit system**: Used on British Aircraft.
Ferrules are made in a variety of shapes, sizes and materials. Aluminium alloy ferrules are used with galvanised or tinned carbon steel cable, and copper ferrules are used with corrosion resisting steel cable.
The Talurit system uses a single swage operation for most small sizes and a double operation on larger sizes on each half of the ferrule. Prior to swaging the ferrule should be positioned 1

to 1½ D (D = cable diameter) from the thimble and with ½ to ⅔ D of free cable protruding from the ferrule. After swaging, the free end of the cable must protrude from the ferrule. A small flash of material is normal and should be removed with a file. If no flash is formed then the sizes of the cable and ferrule should be checked or ascertain that the swage tool is operating correctly.

b) **Nicopress system**: American manufactured cables with wide applications.
Ferrules are all made from copper. Plain copper ferrules are used for galvanised cable and plated copper ferrules are used with stainless steel cables due to electrolysis caused by different materials.
The Nicopress system used 3 operations of the swaging tool. The first is in the centre position of the ferrule, second at the thimble end and the third at the cable end. Nicopress do not specify free of thimble cable dimensions but on completion, the free cable must protrude from the ferrule by at least 1D and it is permissible for the thimble ends to just enter the ferrule.

c) **Other systems**: the cable manufacturer recommendations must be followed.

d) **If plain swage** type terminals and cables are used (i.e. straight in and not looped) then only swaged type of cable may be used to replace them. It is not permissible to use hand-swaged types to replace them.

e) **Interchangeability of parts**: Some of the cable systems appear to contradict each other with the material used for example. It is recommended that you do not mix types of cable and hardware. For British BS specification cable only use the correct BS specification hardware and conversely for American manufactured products using MIL specification cable the correct AN, MS or NAS specification hardware must be used.

6. Although it will not be possible to proof test cables swaged in situ (unless specialist equipment is available). The integrity of such cables must be adequately assured. This may be done by the swage operator making up a test cable assembly and either proof testing this specimen, or destructively testing it, ensuring that it fails other than at the swage. A Go and No-Go gauge should be used, firstly on the tested cable prior to testing, and then on subsequent cables. An over swaged cable is cause for rejection as is an under swaged cable. Over swaging causes excessive work hardening of the fitting and may make it liable to crack and may also damage the cable. If a cable is rejected because of a defective swage it **must not** be repaired by cutting off the unserviceable swage and replacing it, the cable undergoes some deformation during the swaging process and it is a once only operation. Cables of British manufacture are proof tested to 50% of declared breaking strain and cables of American manufacture are proof tested to 60% of declared breaking strain. In the absence of any specific information either 50% or 60% should be used as appropriate. If the cable is not of British or American manufacture, then, as glider cables are relatively lightly loaded the 50% figure may be used.

INSPECTION OF CABLES

General

7. This section give guidance on the inspection of cables and expands on the defects likely to be found as mentioned in section 1. Consideration should be given to carrying out an end-to-end inspection of cables. Hemp or fibre cored cables are sometimes found on gliders, these are not recommended by the BGA and must be replaced at a maximum of 5 years from new.

Wear.

8. Wear is normally found where the cable runs through a fairlead, guide block or guide tube, against a rub strip or around a pulley. The amount of wear can be determined by closely examining the cable with a magnifying glass if necessary and as the cable outer wires wear the flat spots tend to

appear to merge together. At 50% through the outer wires the flat spots will appear to blend together and at over 50% the flat spots will appear to separate again. When a cable is at the 50% wear stage it is deemed to be unserviceable although it could remain in service for a short time until a replacement is available. If a cable is beyond the 50% worn stage, it should be replaced.
It is necessary to slip the cable by disconnecting one or both ends to allow the cable to be moved so that the possible wear areas may be inspected.

Broken wires and strands

Caution

When inspecting a cable for broken wires use a piece of cloth to run along the cable as broken wires will cut your hands and may cause contaminated wounds due to the inclusion of dirt and oil deposits.

9. A broken wire is cause for rejection of the cable. It has either been caused by excessive wear or by fatigue. Very occasionally it is caused by defective cable manufacture. Wear is addressed in section 8. Fatigue can be caused by old age, routing around too smaller pulley for the size of cable, external damage. A broken wire will quickly deteriorate into several broken wires and eventually a broken strand. Eventually either the cable will fail or 'Bird nest' and could cause a control restriction or jam. Cables manufactured from Stainless steel tend to have a shorter fatigue life than galvanised steel cables. Stainless Steel cables are not recommended by the Technical Committee for use on gliders.

Corrosion

10. Corrosion on control cables can be very serious and with little external evidence, severely reduce the strength of the cable. Corrosion can occur at areas of soft erosion where clothing or other elements have rubbed off the outer galvanic layer. If corrosion is suspected the cable may be inspected by bending over a sheet of white paper and look for rust flakes. Rust flakes or external corrosion are reasons for rejection. Corrosion can also make the cable appear stiff to bend.
If cables are liable to corrode but are still serviceable; they may be protected by applying Lanolin or LPS3 or a similar temporary protection compound. Do not use grease to protect cables as grease is hydrosorbic and the cable will rust underneath.

Swaged ends

11. Cable swages should be inspected for slippage, cracks, corrosion and wear.
Normally a small dab of paint is put at one end of the swage so that any slippage of the cable through the swage ferrule can easily be spotted. In the absence of this paint a close visual inspection should be made. Any slippage is cause for rejection.
Inspect the ferrule for cracks, corrosion externally and internally by reaction with the cable and for external wear. Any defects other than very minor external wear is cause for rejection.

Cleaning of Cables

12. Aircraft cables contain internal lubricant, this adds to longevity of the cable. If a cable requires cleaning if at all possible it should not be immersed in solvents as this will tend to wash the internal lubricant away. Cables should be wiped with a clean or solvent moistened cloth to remove any external contamination. If a cable is so heavily contaminated that it requires extensive cleaning it should be considered for replacement as the contamination will have penetrated through the cable and may cause excessive internal wear.

Other defects

13. The cable should be inspected for kinks, cuts, heat damage or any other defects. Additionally all fairleads, pulleys and end fittings should be inspected especially in the areas of high cable wear.