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The Gliding Federation of Australia Inc.

Operations

Operations Advice Notice

No. 01/13

Weak Links – Selection, Application, Safety and Testing of Glider Weak Links

Overview

Weak links are required to protect the sailplane against overloading during launch operations. The strength of the spar of an aircraft is calculated on the basis of a given maximum load. The type and rating of the weak link used during the launch must meet the requirements of the sailplane as described in the Type Certificate Data Sheet (TCDS).

Weak links are fitted to aerotow ropes for the protection of both the sailplane and the tug. Apart from the Piper Pawnee 235 (which has a maximum weak link strength of 750kgs), the maximum weak link strength for other tow planes is limited to 450gs. Weak link requirement will be found in the Aircraft Flight Manual (AFM) towing supplement. For sailplanes, this information is found in the TCDS, the sailplane AFM, and the sailplane placards in the cockpit.

If the specified weak link strength for a heavy glider is greater than the specified strength for the tug, the operator is stuck with the weaker of the two values. Remember, sailplane weak link strengths are the maximum allowable to prevent structural overload of the sailplane; a lower strength weak link strength merely provides a higher safety margin. If the specified strength for a light glider is less than that specified for the tug, a separate weak link of the correct glider strength must be inserted at the glider end in addition to the one already in place at the tug end.

If only one weak link is fitted to an aerotow rope, it must be fitted at the tug end. This retains the protection in the event of the tug inadvertently snagging the rope on an obstacle on the final approach. Exception: a tug fitted with a TOST tow rope retraction system will have the weak link fitted at the sailplane end.

It is essential the tow pilot inspects the weak link and tow rope for serviceability before the day's operation and also after being subjected to a high jolt or load. It is also required that when that weak link fails, the reserve link must also be replaced.

The TOST Weak Link System

The TOST weak link system is an engineered and approved design which prevents aircraft overloading during winch, autotow and aerotow launching. By using this system, the operator is assured of maintaining the manufacturer's airworthiness requirements assuring protection to both tow plane and sailplane.

TOST weak links are colour coded and are available for loads from 80 to 1000daN with a tolerance of 10%. For conversion purposes, one decaNewton is the equivalent of 1 kilogramme force.

The GFA recommends clubs and operators use the TOST reserve insert and sleeved weak link system. This uses two weak links in parallel protected by a steel sleeve. Both weak links have attachment holes at each end and are 8 mm in length. The reserve has oval attachment holes and carries no load in normal operations. If the load exceeds the rating, the weak link will fail and the reserve link will take up the load. If the load is more than a momentary jolt both weak links will fail.

TOST Operating Notes

Replace the weak link insert as soon as damage is visible (e.g. necking). The weak link should always be replaced after 200 launches – an insert is a lot cheaper than an interrupted launch.

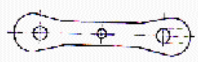
- Replace the weak link insert also after obvious overloading, e.g. after a 'Cavalier[1]' start.
- Use the protective steel sleeve.
- Use only the correct shackles with special screws of defined shaft length to prevent twisting of the weak link and the steel sleeve leading to an increase in the breaking load.
- Never use two equal inserts, e.g. both weak links with round holes would double the breaking load.

Protective sleeves (available in single or reserve sizes) protect the weak link against:

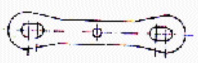
- Deformation and thus uncontrolled change of breaking load;
- Other damage; and
- Premature wear and tear.

TOST steel sleeves have an inspection hole which lets you check quickly whether you are using the correct weak link (colour), and whether, in the case of the reserve-insert weak link, both inserts are still intact. TOST also offer connectors of different types for winch and autotow applications.

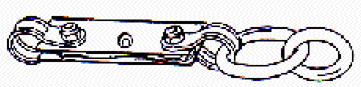
For clubs wishing to use Tost weak links, the available loads, colour codes and Tost part-numbers are as follows:-



Insert - round hole - for single-insert weak link



insert - oval hole - for reserve-insert weak link



Complete reserve-insert weak link with protective sleeve and connecting ring pair for aero tow

Insert number	Colour	Breaking-load daN	Single-Insert (rounf hole) P/N	Reserve Insert (ovale hole) P/N
1	Black	1000±100	110101	110121
2	Brown	850±85	110102	110122
3	Red	750±75	110103	110123
4	Blue	600±60	110104	110124
5	White	500±50	110105	110125
6	Yellow	400±40	110106	110126
7	Green	300±30	110107	110127

Rope Weak links

There are some clubs in Australia who still opt for the old traditional practice of using a small piece of 6-8mm rope inserted between the main rope and the rings at the tug end. The nominal

[1] A winch launch where the aircraft is climbed steeply immediately after take-off, instead of gradually with increasing height into the full climb position

strength of a piece of 8mm with a bowline in it is about 580kg, but quality control on poly ropes is imprecise and there could be wide variations. Because most of the bulk sales of this rope are to either the fishing or telecommunications industry (guy ropes), it is commonly over-strength, as these industries have little interest in weak ropes. Don't use one of these weak-links unless you have them pull-tested. TAFE colleges are useful places for getting this sort of work done.

Shear Pin Weak links

This system is used in the winching and autotow operation and essentially consists of two concentric pieces of cylindrical steel; a solid inner sliding in and out of a hollow outer. A hole is drilled through the entire assembly at right angles to the direction of sliding. A pin is then inserted into the hole. The pin shears when the specified breaking shear strain is reached. Different materials can be used as shear pins. Black gas 1/8 inch diameter welding rods shear at or around 500kg. High tensile gas welding rod shears at around 700 kg. The breaking load is dependant at the rate of load application. All materials used must be tested.

Testing Breaking Strain

If a club operation uses rope as a weak link, the club must ensure that the rope used for the weak link meets and maintains the required strength and standard. A sample must be tested in accordance with a documented procedure and also by a qualified person under controlled conditions. This documented procedure should be recorded in the clubs SMS/Operations Manual.

The weak link rope life limit must be controlled due to wear, grease, dirt, oil ingress and solar degradation. The club must therefore have a procedure for the storage and maintenance of the rope used for weak links. It is essential there be a retest period ensuring bulk/storage rope integrity. There must be a tracking system ensuring that the weak link on each tow rope in service is replaced at regular intervals. It is recommended that each weak link rope used regularly be removed from service and replaced after twelve weeks unless experience has dictated the rope will maintain its break rating for a longer period.

If the club uses Shear Pin weak links for winch or autotow operations the same quality control documentation and assurance is required as the in the aerotow rope requirement. A documented process identifying material description, batch testing and results, identification, labelling, colour coding (if necessary), and possibly manufacture date. The way in which the Shear Pins and weak link mechanism must be stored should also be documented. The clubs SMS/Operations Manual should contain instructions of the Shear Pins life in cycles and time, details including inspection and servicing of the concentric barrel, burr removal, tolerances, and lubrication.

In summary, all weak link systems should be under a system of operational safety management and quality control.

Chief Technical Officer
for and on behalf of the GFA Operations Panel

26 April 2013