

Transport Canada

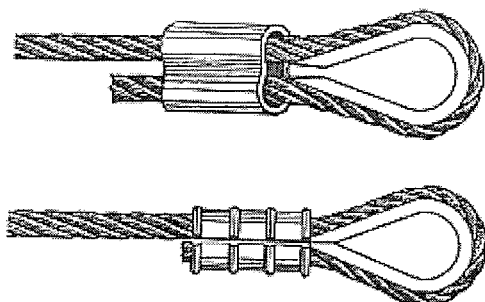
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Aviation Safety Ultralight and Balloon 1/1999

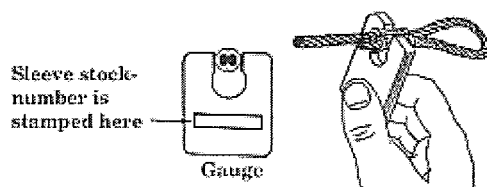
System Safety

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Swaging Methods Cause Structural Failures



Typical thimble-eye splice.

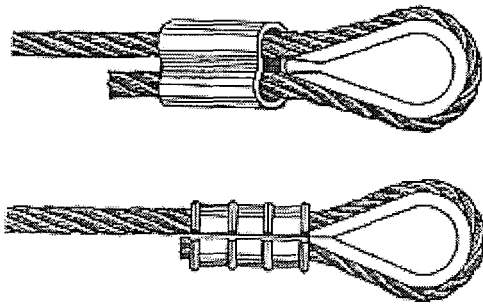


Typical terminal gauge.

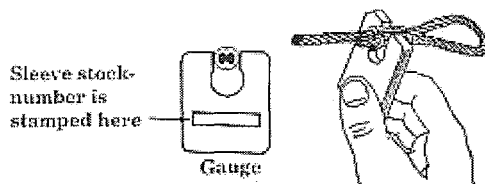
Diagrams illustrate a correctly swaged fitting and the use of a terminal gauge to ensure that the correct sleeve is used and that the sleeve is properly formed around the cable.

I chose to explore this topic again because of the inherent hazards lurking to trap the unwary. You will find considerable detail on the correct use of swaging tools in issue 1/91 of this publication; the article is entitled "Nicopress Safety". The problems associated with improper swaging concern a large number of very light aircraft and hang gliders using cables with swaged fittings as part of their structural integrity. This is particularly critical in high load/stress areas such as wing support. Most of the aeronautical engineering-approved uses of cables and swaging are for ski attachment, control cables and, in some cases, stabilizer support. I understand the use of the cable in very light uncertified aircraft because it does have an excellent strength-to-weight ratio, and it allows the designer considerable flexibility. If you are flying an aircraft that uses this method of attaching major structure, the word is caution. The strength advertised is probably there, but only if the cable is swaged correctly with the approved tools and sleeves for the specific cable. The next step is to confirm that the swage is solid by using a special go/no-go gauge. Then it is the owner's responsibility to maintain the original strength of the fitting by good maintenance and protection from corrosion caused by rain water or

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The Phantom II ultralight descended and impacted the ground out of control after failure of the outboard forward wing support cable/swage. Witnesses reported the ultralight turned from north

to south and upon levelling, the left wing snapped upward, the right wing collapsed and the ultralight entered a diving turn to the ground. Post accident tests disclosed all four cable assemblies were manufactured with the Nicopress oval M sleeve, but were swaged with the wrong swaging tool; one that was slightly larger for swaging the oval P sleeve. The cable showed evidence of failure at the Nicopress swaged connections. Tensile tests revealed the improperly swaged connections failed prematurely because of slippage at the connections, probably caused by poor maintenance and improper installation of the swaged fittings.

The ultralight Banshee was assembled at an abandoned airport, then test flown by an international ultralight company salesman. The non-rated pilot, who was planning to buy the ultralight, then flew the vehicle to familiarize himself with its flight characteristics when a wing folded with fatal consequences to the pilot. Witnesses reported that after flying a short time, the pilot started an approach, but, when the ultralight was about 50 to 60 ft. AGL, one wing folded then the aircraft crashed and burned. The investigation revealed that a structural cable had failed at a swage fitting. There was evidence of non-uniform crimping of the swage fitting. Two types of fractures were found where the cable failed: shear and ductile. The shear failure was predominantly located at the surface of one bundle of wire strands at the swage fitting. The ductile fractures were noted on the remaining internal strands. The plastic fuel tank installed above the pilot ruptured on impact, spilling fuel on the hot engine, which erupted in flames with fatal burns to the pilot.

The pilot of a newly purchased Airmass type ultralight was en route to his home. After landing to refuel, he took off, circled back over the field, then added power and began to climb. At this point, the left wing folded up from the root and the ultralight impacted the ground in a steep nose-down attitude, fatally injuring the pilot. An investigation revealed that both left wing flying wires or cables had separated where they were routed over thimbles for attachment to the hang cage. The Nicopress sleeve (swage fitting) on one of the cables had been installed over the plastic coating on the cable, rather than directly on the cable.