CLOCK LINES – Appendix

Load bearing line crimps

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Where an eye splice is required in a clock line, the writer has developed a method of using what he considers a neat solution based on the use of crimps, this solution being applicable from the largest lifting and rigging applications right down to beading necklaces. One such application is used for fishing lines (sometimes called 'leaders') and, being subjected to significantly higher transient (snatch) loads than any that might be occasioned by a clock line in normal use, have perfectly adequate strength.

I describe the manufacture of an oval crimp (tube) but the most successful anglers appear to use commercial figure-of-eight aluminium or stainless steel crimps. For maximum strength, the line is crimped at 90 degrees to the way the writer makes and uses his crimps (Figure A1, upper), but to do so does need a specially-sized crimping tool.

An eye splice benefits from sharing the load between the two halves of the splice, which means that the splice actually only needs to transmit (in shear) approximately half the driving weight load to the other side of the splice – Figure A1, lower.

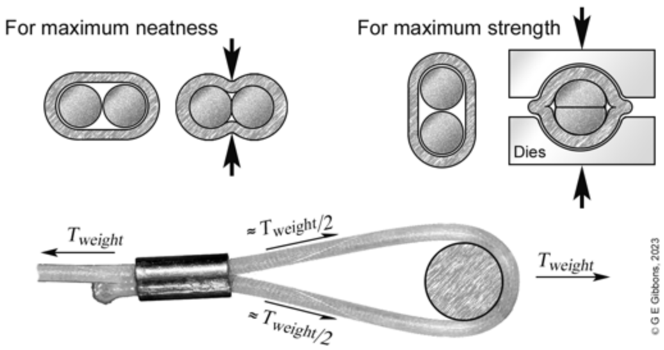

Figure A1: Upper: two different methods of crimping an oval crimp, and (lower) the loads in the spliced eye

Manufacture

Figure A2 shows the sequence I use to make a crimp splice, and is a method the writer has successfully used for 1.5 mm and 0.6 mm stranded bronze line as well as 1.5 mm and 0.6 mm monofilament nylon line. Crimps are made from brass or bronze wire drilled to give an internal circumference 10% over the sum of the line circumference plus twice the line diameter, *d*, i.e.

$$1.1(\pi.d + 2.d)/\pi$$

For 1.5 mm and 0.6 mm lines, this gives drill sizes of 2.7 mm and 1.1 mm respectively. The outside diameter of the splice is not critical but should be no greater than twice the line diameter if cracking when squashing or crimping is to be avoided. Length should be around three times the line diameter.

After drilling, the splice needs to be squashed in several stages around a drill shank of the line diameter plus the 'little over', annealing to red heat before attempting to squash the tube and after the final squash. One or perhaps two intermediate annealing cycles are also wise.

After the final anneal and any finishing to the crimp, the line is doubled back through the crimp and positioned to give the correct line length. If monofilament, melting the end of the line to form a blob of nylon perhaps gives a touch of added security against pull-through, though in practise it has proved unnecessary. A drop of cyanoacrylate (Superglue) can also be added before final crimping with a pair of blunt end nippers; while the bond strength on nylon is not good (and standard Superglue is far from flexible), the cyanoacrylate is not subjected to any flexing. Nor is it the primary load-carrying medium; like bricklayer's mortar, it is essentially less of an adhesive and more of a bedding compound.

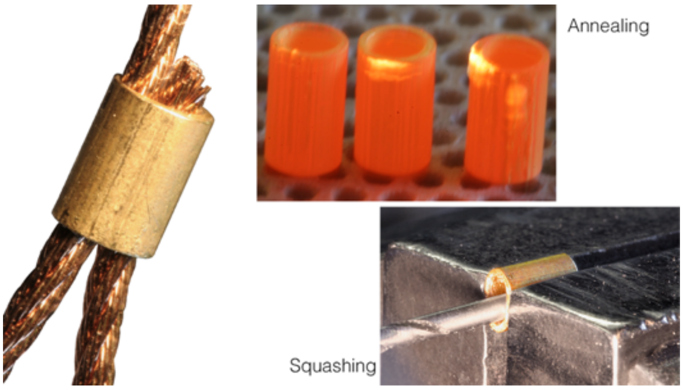

Figure A2: Manufacturing sequence for line crimps

Strength

To get a feel for the strength of the crimps, I undertook simple load trials on two 600 mm lengths of the 0.6 mm nylon monofilament fishing line fitted each end with my crimps. The trial rig is shown in Figure A3.

Figure A3: Shown applying a line tension of 10 times the working load, the trial rig used a long carpenter's sash cramp

The first trial (crimps with cyanoacrylate) was taken to 6.5 kg (approximately 10 times the load per fall on the lines as installed in the (Vienna) clock for which they were intended) and maintained for 1 hour with no sign of slippage within the crimps. The second trial (crimps not using cyanoacrylate) produced an identical result. In both cases (at 6.5 kg) the stretch was measured at 70 mm over the 600 mm length or, if linear, a little over 1% at the working load of 0.625 kg (line stress ≈ 22 MPa

Finally, the lines were taken to failure; one failed just below a crimp and one at mid-length (nowhere near a crimp). Both failed at 11 kg or about two-thirds the claimed breaking load for the line, equating to an ultimate tensile strength (stress) of about 375 MPa. This is not high for nylon, but it probably includes a significant degree of tertiary creep at my loading profile.
