EVALUATION OF A FAILED WEBBING PARACHUTE STRAP

I am involved in the sewing and assembly of webbing products for certain life-safety applications, particularly industrial safety harnesses and climbing harnesses. As such I may have some relevant expertise as to the appropriate use of webbings, but I have very little knowledge of the design and manufacture of life-safety webbings in general.

As such I am unable to assess the exact nature of the webbing with regard to its chemical make-up (nylon or polyester) and yarn composition. However it appears to be a polyester webbing of moderate to high quality, which may be suitable for life-safety purposes, probably having a strength in the range 18-20 kN. While it may have appeared adequate for the task, I would expect a webbing of slightly higher quality to be used.

Regarding the condition of the webbing strap used to connect to the parachute, it is in relatively poor condition. It shows significant damage in some areas, and possibly fusing. It appears to be quite old, though this is difficult to assess. Its strength would have been reduced from its original condition, due to a combination of chemical ageing, UV degradation, abrasion, and possibly stress, all contributing to a deterioration of the strength of the webbing. It is unlikely though, that the strength would be reduced by more than 30-40% from the new condition.

It is usual practice for any operator with such equipment to maintain an inspection programme for webbing and other life-safety products, and the condition of the webbing would be assessed on a number of factors. Considering that the strap is a critical component, I expect that most prudent operators would have retired the failed sample.

Furthermore, it is usual practice to replace webbing items, regardless of their visible condition, at a set time interval, which varies depending on the industry, country, and degree of use. Typically this would be five years, though it can be longer, and much depends on the safety margin built into the product. I recommend that my own products be unconditionally retired at 10 years of age.

For most life-safety applications in Australasia and North America, webbing is required to undergo a process during dyeing in which stabilisers are added to the dye to improve the resistance of the webbing to ultra-violet light. This is not commonly done in Europe. However it may not be possible to determine whether this webbing received the UV treatment.

Regarding the design and construction of the parachute strap, I consider that the sewing of the webbing has been performed in a professional manner and is likely to provide a strength at the seams well in excess of the webbing strength.

However the absence of a ring or other connector where the strap was connected to the parachute cords is an area of concern. Attachment to a ring can be expected to increase the strength of this connection area of the strap. The cords could have had a moderately severe cutting effect on the webbing, which would reduce the strength compared to a hypothetical version fitted with a ring.

The degree of strength reduction would depend on a number of factors, including the thickness of the cords and the quality of the webbing yarn. The loss of strength could probably have been mitigated by providing an overlapping piece of webbing, which provides protection against the various forms of degradation already discussed, as well as giving more resistance against the cutting effect of the cords, which appears to be the cause of the failure of the webbing. This use of overlapping webbing or fabric is common practice in many webbing products and has been done at the other end loop of the strap.

To test the difference in strength that a steel ring might have made to the webbing strap, I made up two test samples using short sections of the parachute strap. One sample used a steel ring to connect the parachute cords to the webbing, while the other had the cords sewn directly to the webbing in a similar manner to the original strap. These are shown in the photograph below.

The testing was performed by Imtest Laboratory in Christchurch, using a slow-pull tensile testing machine capable of 50 tons loading.

In the test replicating the parachute strap configuration, the cords started to break at 13.4 kN, and the load diminished steadily as they continued to break. The webbing remained intact, so this test did not replicate the failure mode of the accident.

The sample with the rings held 15.1 kN before the first cord broke, and held a peak load of 16.1kN as the cords broke progressively.

As the failure mode was not replicated it is difficult to form any reliable conclusions, but of course there can be differences in failure modes depending on whether loads are applied via a slow-pull process such as this, or by sudden impact, as in the case in point. Commonly I find different failure modes in a series of tests in which the test samples have been created, as best we are able, to be identical, in that failure may occur sometimes in the webbing and sometimes in the stitching.

In summary, it seems that the failure of the webbing strap probably resulted from a combination of three factors:
1. Use of webbing that might be regarded as "adequate" rather than top-quality for this kind of application;
2. Deterioration of the webbing due to damage and ageing;
3. Poor design around the attachment area - particularly in the lack of a connecting ring and abrasion sleeve.

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