DEVELOPMENT OF HIGH TENSILE STRENGTH WEBBINGS

Russell J. Neff
Phoenix Trimming Company

High tensile strength webbings are being used today for a variety of purposes, many of which have no connection with parachutes. I shall, however, attempt to limit this discussion as much as possible to those webbings which are used primarily by the parachute industry.

Prior to 1938, almost all of the high tensile strength webbings, being used in the parachute industry, were made of linen. This was true because linen was the only fiber with a high enough tenacity to give the desired strength in the finished product.

Early in 1938, with the threat of war in Europe pointing to a possible shortage of linen, the Air Force called upon the Phoenix Trimming Company to start an experimental development of nylon webbings.

At this time, nylon was an unknown quantity. Reports from Du Pont indicated that it had an amazing tenacity, but whether it could be twisted and woven into a webbing, without considerable loss in tenacity, was not known.

The first problem we encountered in the weaving was static electricity. This was overcome in the most part by the addition of humidifiers to the weaving floors, so that a high humidity could be maintained.

The second problem involved our equipment. The extremely high tenacity of the yarn and the necessity of holding it under great tension began to cause loom breakdowns. It seemed that as soon as we would reinforce one part of a loom another would break. By the time we had completed the development of these webbings, our looms were practically entirely rebuilt.

The third problem involved the webbing itself. We originally decided to follow the linen specification faithfully, using the same weave patterns, warp ends and picks to manufacture corresponding types in nylon. We soon found, however, that this would not give us satisfactory webbings. While the tensile strength was higher than the linen, the webbing was much too sleazy and thin to be sewed properly.

Therefore, in order to "firm-up" the webbing, it was necessary, in a number of cases, to add picks, warp ends and, as was the case in Type 10, binders. This successful stiffening of the webbing was, strangely enough, to be the cause of much trouble in subsequent developments.

With the nylon specification almost complete, work on it was temporarily interrupted, partly because weathering tests on the webbing were not satisfactory, but mainly because of the limited supply of nylon.

By this time, the war had already broken out in Europe and was threatening to overflow its boundaries and eventually engulf us. For this reason, we needed high tensile strength webbings that could be delivered in large quantities immediately.

At the request of the Air Force, the Phoenix Trimming Company, in cooperation with the Murdock Webbing Company, undertook the development of high strength cotton webbings. The only real problem involved in this development was to find a cotton yarn that had adequate tensile strength to enable us to manufacture a webbing strong enough and yet thin enough to be of use. While this was by no means a simple problem, suffice it to say, that adequate yarns were soon developed and a specification was written that in many respects was an improvement over the old linen specification.

How many millions of yards of this webbing were made and used in World War II no one will ever know, but certainly they were an all important factor in the successful conduct of the war.

During the war, we continued to develop nylon webbings, using improved yarns, developed by the Du Pont Company, and, by the war's end, millions of yards of this webbing were already in use.

Towards the end of the war, service reports on parachute harnesses made from nylon webbings indicated that the abrasion resistance of nylon was not adequate for this use. Therefore, the Material Laboratories at Wright-Patterson AFB undertook an extensive experimental program in an attempt to devise a method of increasing this abrasion resistance. After more than two years of laboratory and field testing, an impregnation of polyvinyl butyral plastic, known commercially as Merlon, was approved. This impregnation increased the abrasion resistance of nylon webbing by roughly 50%.

This treatment, coupled with the greatly increased production of the Du Pont Company, stimulated a great increase in the use of nylon webbings.

At the same time this treatment led to a new and, as yet, unsolved problem. As I mentioned before, during our initial development work with nylon, we found it necessary to "firm-up" the webbing to increase its sewability. At the time that the treatment was approved, we failed to realize that it would act as a stiffening agent and, while increasing the abrasion resistance, also make the webbing boardy.

As service complaints began to come in, we realized our mistake and reduced the pick count in harness webbings, bringing it down from 30 picks to 22 picks. This, combined with improved methods of applying the treatment, has softened the webbing to a great extent.

However, we still have a low temperature flexibility problem, brought about by the fact that the plastic will freeze. In an attempt to solve this problem, we have done a considerable amount of experimentation, both with different treatments and with new types of nylon yarn. Obviously, the ideal solution would be a nylon webbing which required no treatment. Tests made in the past prove that this is possible using a 240 denier 12 filament yarn. Unfortunately, Du Pont is no longer manufacturing this yarn. They are, however, manufacturing a 260-17 filament yarn and experiments with this have been very promising. The other possible solution is the use of a new treatment.

In this respect, the most promising discovery has been a natural latex compound, manufactured by the Rubber Corporation of America. It is applied in the same way as Merlon, and, up to now, seems to be just as good as Merlon, insofar as abrasion resistance is concerned, and has the added feature of maintaining low temperature flexibility.

We do not claim that this is the answer to the problem. A great deal of testing must be done before it could be accepted as a substitute for Merlon. We do, however, feel that it shows great promise. We are confident that this problem, like its many predecessors, will soon be overcome.

During and after World War II, it became evident that any future war would be conducted, in great part, by the aerial delivery of men and equipment. Since some of the equipment the Air Force would be attempting to deliver by air would be extremely heavy, it became evident that stronger webbings should be developed. With this in mind, the Phoenix Trimming Company undertook an experimental contract with the Air Force for the development of a 20,000 pound and 40,000 pound webbing.

At the time that this contract was undertaken, we were not at all sure that webbings of such strength could be manufactured. However, our first experimental runs convinced us that it could be done and eventually we delivered to the Air Force 500 yards of a 22,000 pound webbing and 500 yards of a 46,000 pound webbing. While these webbings have not been extensively used as yet (there has been a considerable amount of interest shown in them lately), they indicate that webbings strong enough to do almost any job of aerial delivery that might be required of the Air Force, can be manufactured.

Up to the present time, most of the high tensile strength webbings are nylon. Recently much experimental work has been done with other fibers. In the past year our company, alone, has made experimental webbings from such synthetic fibers as dacron, orlon, dynel and X36, and, while some of these fibers seemingly have no place in this field, a few have shown great promise. For example, dacron is, at present, being seriously considered as a substitute for nylon in all applications where low elongation would be desirable.

In conclusion, I might say, without fear of contradiction, that during the past ten years great improvements have been made in high tensile strength webbings, and yet I wonder if we have even scratched the surface of the possibilities. With science continuing to discover new fibers and improved methods of dyeing and treating, experimental and development work continues to be of prime importance. Only through the continued cooperation of the Air Force and industry can we be sure that the best possible webbings are being used in our parachute program. Past performance would indicate that this cooperation is assured and the future is bright.