DEVELOPMENT OF IMPROVED STRENGTH WEBBING

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The following paper is intended to cover the various aspects encountered in the development of improved strength webbing now generally in use by the various branches of the Armed Forces, discussing and dealing specifically with webbing utilized by the Wright Patterson Air Force Procurement Center.

In introducing the subject, it is necessary that one understand the target properties attendant to the development of the project under discussion. In addition to conforming in all respects to the current specifications covering the various types and weights of webbings, the target properties cover:

1. Reduction of 20% in manufacturing costs exclusive of yarn.
2. Strength at least equal to present specification values with a plus tolerance of 10%.
3. When dealing with Condition R (resin treated) webbing, a maximum of 15% abrasion loss is required.
4. The seam efficiency requirements are set at at least 80% of the webbing strength prior to seaming.
5. An increase in the availability re-procurement of the heavier webbing by altering constructions to enable manufacture on lighter looms at higher speeds and/or the use of a greater number of spaces per loom.

Heavier Webbing - Specification MIL-W-4088A

In the heavier web group, types N-6 to N-17 inclusive are being studied excluding types 12, 14 and 15. Representative leaders in the field of heavier webbing production, such as Murdock and Phoenix, have been most cooperative. It is significant at this point to mention that the conventional warp beam method versus the warp creel method, utilized by these manufacturers, enables the laboratory to evaluate samples woven using these two methods.

In setting a basic pattern, Type XIII web was selected. This web is currently utilized in human parachute harness. One of the initial experiments consisted of a reduction in the number of ends from 225 to 217 ends of 210 denier, 10 ply and a reduction in picks from the 25 picks of 210 denier, 7 ply currently specified. Alternate trials of 18, 20 and 22 picks of 210 denier, 8 ply were woven in 20 yard lengths. The 20 pick specimens prove satisfactory. However, the 18 pick trial was discarded, due to sleaziness.

Further experimentation using Type N-XI webbing as a substitute for the double plain currently specified using the same endage, gave an abrasive loss far in excess of the 15% called for in the target properties previously listed. Considering the vagaries of the present abrasive bar used, the above abrasive loss may be measurably increased when making further runs.

When conducting experiments on the N-X webbing, the endage was not altered. However, the pickage was reduced to 18 and 20, rather than the 22 picks specified. The resultant web has a softer weave which will give better sewing and fabricating characteristics. The test data obtained on these trials Condition R showed the specimen to meet physical requirements.

Trials conducted on Type N-IX covered experimentation utilizing 26 picks of 10 ply in lieu of 28 picks 3/3 (9 ply) currently specified. Laboratory tests on this web shows that the revised construction meets all specification requirements.

When considering Type VI, it was decided to maintain the 120 ends currently specified in order to maintain a satisfactory safety factor. Experiments conducted, however, dropping two picks, showed the submitted sample to meet the target properties required by this development project.

Experimentation in weave design wherein the basket weave was substituted for the current twill, omitting the center break, gave a contemplated saving of approximately 20% in yarn cost. Actual mill trails, however, showed this substitute in weave to be impractical due to the inability of the weaver to beef-up the samples sufficiently to maintain adequate strength.

Lighter Webbing - Specification MIL-W-4088

The major part of the experimentation on the lighter webbing was conducted on conventional ribbon type looms at the plant of R. G. Buser Company. In marking up the warps, there was no slashing operation and considerable trial and error was encountered prior to the selection of a suitable warp size.

In this group, Type II was selected as a basic pattern and experiments have been completed wherein no warp twist was utilized. The current specification calls for 268 ends and 34 picks and experiments were conducted with 2 additional picks and the same endage. A third experiment consisted of 34 picks and 20 ends less than specified and a fourth experiment consisted of 30 picks with 30 ends less than specified. These changes were deemed feasible due to the high safety factor in the present day web. A satisfactory strength tolerance of

10% was maintained in all but the last of the above trials. It was noted that the seam efficiency, however, was considerably less than the 80% required and it is felt that increased seam efficiency might result through the use of lighter sewing thread and a smaller size needle. In the above experiments, 5 ply nylon thread and a number 26 needle was utilized.

Type VIII webbing was made utilizing 60 space ribbon looms. However, due to the increased load, only 30 spaces could be utilized. From the standpoint of availability, this is encouraging. However, from a cost standpoint, an estimated additional cost of $20.00 per 100 yards would have to be considered. Type VIII webbing was made in 1 pick increments ranging from 15 to 18. The samples were tested in Condition U and satisfactorily passed all physical requirements using the standard 132 end construction.

Tubular Webbing - Specification MIL-W 5625

In considering the tubular web, elimination of ply twist effects a saving in throwing cost of approximately 35¢ a pound. With the omission of the ply twist and running 8 ends as one, we obtained a strength of 3950 pounds versus 3000 pounds specified on the 1 inch web and on the 1/2 inch web, comparable figures of 1300 pounds test versus 1000 pounds specified. On the 1 inch web, an increase of 12-1/2% additional ends may permit the use of 6 ends run as one rather than the 8 ply now specified. The test data obtained on these trials indicate the seam efficiency to be on the low side. However, a change in needle size may bring the sample within the range of the target properties specified. Trials on the 3/16 inch and 3/4 inch tubular web indicate that these widths will meet or exceed present specification requirements.

Dyeing Techniques

Considering the target properties, calling for a 20% reduction in cost, dyeing techniques deserve considerable study. Until quite recently, the standard manufacturing practice was to yarn dye the stock prior to weaving. Considerable experimentation has been conducted, however, using the Molten Metal, the Williams Method and also the dyeing techniques employing conventional Smith Drum type equipment. Trials conducted in the current project indicate that excellent penetration and depth of shade can be accomplished through the use of satisfactory techniques. A shrinkage of approximately 8 to 10% is generally accepted when piece dyeing the heavier type webs. In looking toward the future, some manufacturers are hopeful of combining the application of Merlon Resin within the dye bath so that a single operation will suffice rather than the two separate applications now required.

Conclusions

In drawing conclusions utilizing data available up to this moment, it appears that the elimination of twist is not feasible on heavier webs but should prove quite satisfactory on tubular webbing and on the lighter web types 1 to 5 and 12. In the heavier webs, increased twist gives added bulk and defeats one of the prime target properties of reducing costs. This increase in bulk, if substantiated, might bring about major changes in the design and assembly of harness used in the parachute pack assemblies.

It was interesting to note that all manufacturers contend in discussing the various development aspects of harness webbing that were the use of ply knots permitted, a major saving would be affected in manufacturing costs. They point out that production would be stepped up considerably, due to longer runs of their warp stock as contrasted with the present method of using the short lengths, brought about by a warp running out, as a filling stock.

In the heavy webbing group, manufacturers point out that it is not feasible to eliminate ply twist due to poor running conditions which would insue.

Some interesting experiments are currently being conducted wherein feasibility of fusing rather than tying free ends of nylon plied stock is being thoroughly investigated. In the fusing of plied yarn at the present time, a reduction in strength from approximately 35 pounds to 7 pounds takes place. The angle of fusing gives promise of furnishing some very interesting and pertinent data.

In closing, the writer expresses the personal opinion that in the very near future, separate specifications will be drawn for Condition R, resin treated, and Condition U, untreated parachute webbing.