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Footwear Fundamentals

WHAT'S IN A STITCH? Part 1

From the earliest times, shoe uppers have been sewn together. It was a practical method that required just simple awls or needles to produce a strong join using readily available raw materials. It was however a time-consuming hand operation that helped to keep shoemaking a craft occupation until the early 1850s when the first treadle-operated sewing machines appeared. Overnight, output rose and costs fell, setting the stage for a mass-production shoe industry. Up until the mid-20th Century, soles were also mostly attached by stitching. Although most of these are now either stuck-on or direct-moulded, we still sew shoe upper sections together? For three good reasons:

- With most traditional shoemaking materials it is still the best and most flexible way to join them
- Lasting is easier if some shape can be introduced into the upper and the best way to do this is to cut the sections using sprung patterns and sew them together 'on the round' using a post machine
- Stitching can be used for decoration—on a standard sewing machine if kept simple or a programmable computer machine if complex

Having said this, upper sewing or 'closing' is all too often underrated. In fact it calls for a high degree of skill on the part of the machinists involved if it is to be carried out quickly as well as correctly.

GOOD PREPARATION

Good preparation helps to ensure accuracy in all sewing operations. From the very outset, patterns must fit together properly and have adequate allowances for seams and underlays. Bulk production patterns should also be carefully checked for fit before tooling of whatever type is ordered. For example, prickers or notches in cutting dies must be visible on all cut sections, especially when cutting multi-layers.

The same applies to stitchmarkers, which must leave a mark in the correct place and also be kept clean so that they leave a clean narrow line rather than a thick smudged one. Whatever the medium or method used, marks must be easy to see and, wherever possible, should be just covered when the sections are placed together to avoid unnecessary cleaning later on.

Three basic skives are used to reduce the edge thickness of upper sections for closed seams, underlays or folding (*Figure 1*). Skiving also improves the upper's appearance and avoids ridges inside the shoe which might cause discomfort or blisters. It must not stretch or distort the material however and the width or 'scarfe' should stop short of the stitching so that at least one row passes through the full substance of both layers for maximum strength (*Figure 2*).

Figure 1 – Edge skives

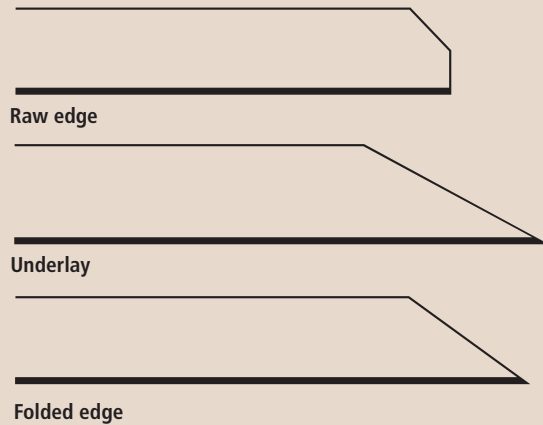


Figure 2 – Twin row lap seam with first row passing through full substance of both layers

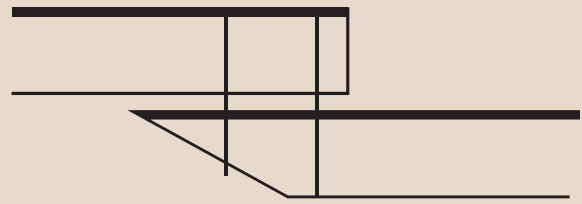


Figure 3 – Lockstitch

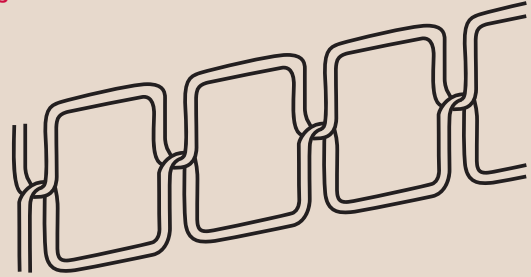


Figure 4 – Chain stitch single thread

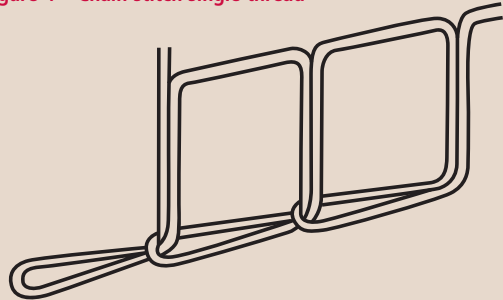
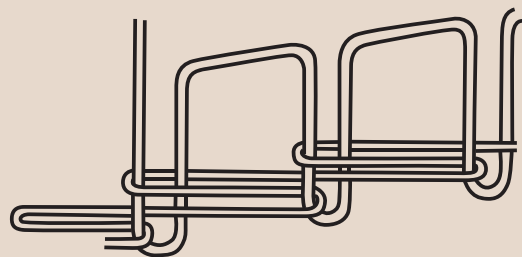


Figure 5 – Chain stitch double thread



CREDITS: FIGURE 1-5: LEICESTER COLLEGE, UK

BASIC STITCHES

Traditionally, the two basic types of stitch used in footwear are the lock stitch (Figure 3) and the chain stitch (Figure 4). The double chain stitch variant (Figure 5) is also often used to prevent run back on the seam.

Lock stitch is the most widely used and has a simple formation with a similar appearance on both sides. Correctly formed, it creates a strong seam with good abrasion resistance. It is formed by looping a top thread from the needle with a bottom thread from the bobbin and adjusting the tension so that the 'lock' point where the two cross falls in the middle of the materials being sewn. Incorrect tension leads to unbalanced seams which can fail in wear. The lock stitch is used for all types of functional seams and decorative stitching.

Chain stitch is where the single version uses a single top thread and although it looks similar to a lock stitch on the surface, the underside reveals a series of loops interlocking together. The double version has top and bottom threads and, although it looks virtually the same, is more complex as can be seen in the diagram. The advantage of the single is that there is no bobbin to keep changing and, with the double, a large bobbin can be used. Chain stitch machines are also very fast and, by using the double stitch, there is no need to back-stitch as long as a short length of thread is left. **Back-stitching is normally done to prevent the thread(s) coming undone at the beginning or end of the stitch path on all other stitch formations.*

Zig-zag is a lock stitch variant formed by a swinging needle machine and used to produce butted seams where the two sections are placed edge to edge instead of overlaid. It is mainly employed where it can be covered by a back-strap or similar section as it is flatter than an overlap seam.

Single Thread Overlock is used for seaming the upper to the sock or insole on sewn-in-sock force lasted constructions and is formed on a Strobel or similar type of overlock machine.

SEWING ESSENTIALS

Machinists must have good eyesight for following marks or edges of sections accurately and to thread needles. Colour blindness can affect colour matching threads to uppers or upper sections together. Hand, eye, leg and foot co-ordination is also important as machinists must pick up sections, place them together quickly and accurately under the needle, lower the presser foot and sew a correct path

with back-stitching as necessary. They must also be properly trained in basic functions such as layout of sections for easy pick up and handling, use and control of machine speed, and the creation of even seams if the job is to be done properly and at an economic work rate.

Good adjustable lighting—especially under the sewing head—is needed so that machinists can see the work clearly. Adjustable seating also helps as it allows them to maintain a comfortable position throughout the day, be able to reach both foot treadle and knee lift and, at the same time, have a clear view of the work in hand.

SEWING THREADS

We cannot make seams without thread and this is a complex subject. Besides raw material and count, it is a thread's construction that determines its properties. Sewing threads are yarn twists that consist of at least one or more usually two or more yarns and their properties are specified by:

- Construction
- Twist
- Ply
- Cord

While a yarn's construction defines the individual thread type, twist, ply and cord define the general construction parameters of all threads.

TWIST

Yarns and threads are twisted in the course of which the fibres or filaments are twisted on a longitudinal axis to interconnect them and it is consolidation resulting from this that imparts the strength. Twisting therefore creates a compact thread and defines its sewing performance. The two twist directions are best described as S and Z (*Figure 6*). Depending on the direction of twist the centre stroke of each letter coincides with the diagonal twist of the yarn. They are sometimes also referred to as left and right or clockwise and counter-clockwise twists.

Threads are usually twisted in the S direction and yarns in the Z. To stabilise a thread and optimise sewing performance, it is important that yarns and threads have a counter-rotating twist. The reason that a Z twist is used for ply yarns and an S twist for yarns lies in their different applications. Z twist threads are best for standard lock stitch machines because they tighten as a result of the needle and

hook positions and the movement of the needle thread from the eye of the needle, while S twist threads loosen, adversely affecting the sewing process.

The number of turns in a yarn or thread defines the helix angle, which is expressed in turns per metre. A low number denotes a large angle and a high number a small one. The level of twist selected for a specific thread influences sewability and performance. Threads with too high a level are said to be 'open' and, on 0 machines, the hook may grab into them and tear them. Those with too much twist tend to snarl and are too 'lively', which can cause knots and loops, leading to erratic sewing and thread breaks. Coarser yarns or threads have less twist than finer ones, so the level of twist must match the weight of the material and the nature of the seam involved.

PLY

This identifies the number of single yarns in a thread and how they are combined. Most threads are two- or three-ply constructions consisting of two or three component yarns. Very rarely, there are one- or four-ply threads (*Figure 7*). When stating a thread size, the ply is also usually given. Ply also affects sewing performance and appearance. Three-ply threads look better on coarser seams as the cross-section is almost circular, while two-ply appear flatter. Two-ply also perform better than three and usually have greater twist making them more compact and uniform. They are ideal for multi-directional automated machines where there is a tendency for twist displacement.

Figure 7

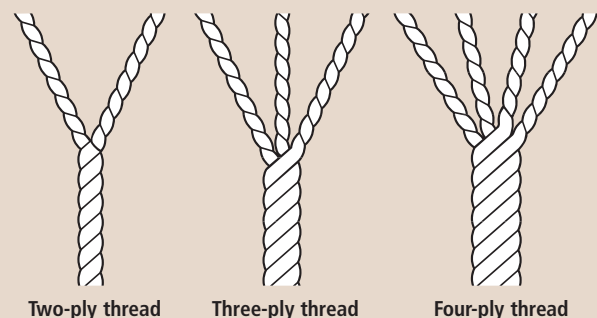


Figure 8

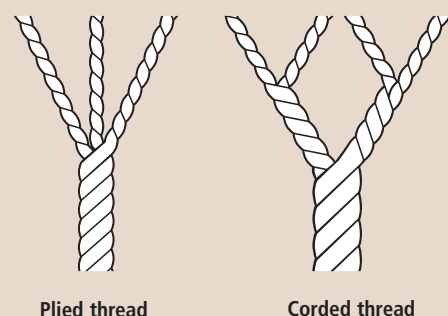


Figure 6

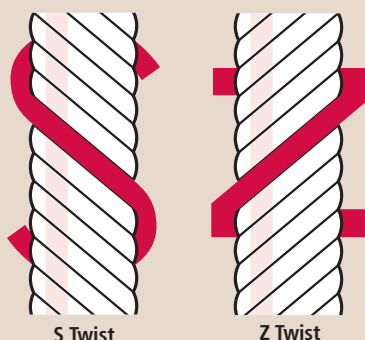


Figure 9 – Spun thread

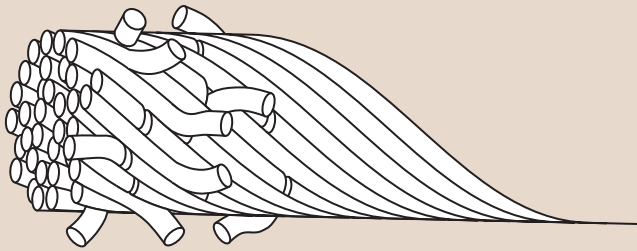
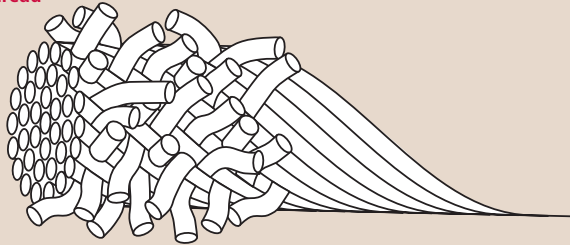


Figure 10 – Corespun thread



with the core sheathed but not fully covered and will include two, three or even four multifilament cores, depending on ply. Both core and cover are usually of polyester giving a smooth grip and textile surface like fibre yarns but much greater strength and abrasion resistance. They are mainly used for specialist multi-directional sewing operations.

Multifilament – now, single yarns are each made of up to 200 fine continuous filaments, generally polyester or polyamide (Figure 11). Multifilament threads are widely used for footwear and leather goods as they have a smooth, glossy surface and, because of

CORD

Practically all commonly used sewing threads are 'direct' or one-level consisting of two, three or occasionally four yarns and are directly made from these yarns in one operation. Multi-level or corded threads are made of more than one ply, going from yarn to ply and then ply to corded thread (Figure 8).

YARN

Sewing thread type, whether multifilament or corespun, is determined by yarn construction. Fibres and filaments in their different forms, schappe spun or cut staple spun, smooth multifilament, monofilament, textured filament or combined, the base for every thread except monofilament.

COMMON THREAD TYPES

Spun – these have single yarns consisting of short, cut staples torn to a uniform 40mm length and joined by twisting (Figure 9). Mainly made from polyester, they have largely lost out against multifilament threads for footwear applications.

Corespun – here, single yarns have a multifilament core covered by fine fibres combining the strength of multifilament threads with the good sewability and surface properties of spun yarn (Figure 10). Core to cover ratio is usually two thirds to one third

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NUMBERING OF SEWING YARNS

Metric (Nm) indicates metres of yarn per gramme – eg: Nm 120/1 = 120 metres per gramme. The number to the right of the diagonal stroke denotes the number of individual yarns (folding number) in a ply-yarn – eg:

- Nm 80/2 = two yarns each of 80m total weight 2g
- Nm 120/3 = three yarns each of 120m total weight 3g

Both have the same cross-section but individual yarns of different length and both weigh 25g/1000m.

**The same length and weight give the same cross-section.*

Label (No.) was developed from Nm but does not indicate folding number from the quantity of individual threads in the ply-yarn. Used to describe the thickness of a thread without providing technical details, it is based on the cross-section of a three-ply ply-yarn even when it involves a different folding number – eg:

- No. 120 may be Nm 80/2 or Nm 120/3
- No. 100 may be Nm 65/2 or Nm 100/3
- No. 75 may be Nm 50/2 or Nm 75/3

**The lower the number, the coarser the yarn.*

English cotton (NeB) is used to classify cotton yarns and shows how many 840 yard (768.08 metre) hanks weigh one pound (451.59g) – eg:

- $$\text{NeB} = \frac{\text{number of 840 yd hanks}}{1\text{lb}}$$

(NeB 60 represents 60 hanks of 840 yd)

A label number is based on the cross-section of a three-ply yarn even when there is a different folding number. A three-ply yarn can also be shown as NeB 40/3, so the system is still often used for synthetic yarns, regardless of their raw material. Because synthetic yarn is usually two-folded, NeB 40 is the usual way to express NeB 40/2 as against a two-folded cotton yarn which will always have the full mark NeB 40/2. It is normally used in Asia for polyester threads manufactured by the cotton or three cylinder spinning technique.

Tex (Tex) is an effort to concentrate the various classifications of yarns and ply-yarns. Based on the SI units system, it shows how many grammes 1,000 metres of a single yarn weighs, so one tex is the size at which a one kilometre strand or yarn weighs one gramme (1 tex = 1g/km) – eg:

- One yarn is Nm 40 (40m = 1g), so 1,000m is 25 tex (1,000 ÷ 40 = 25g).

**The higher the tex the coarser or stronger the yarn, the lower it is, the finer it is.*

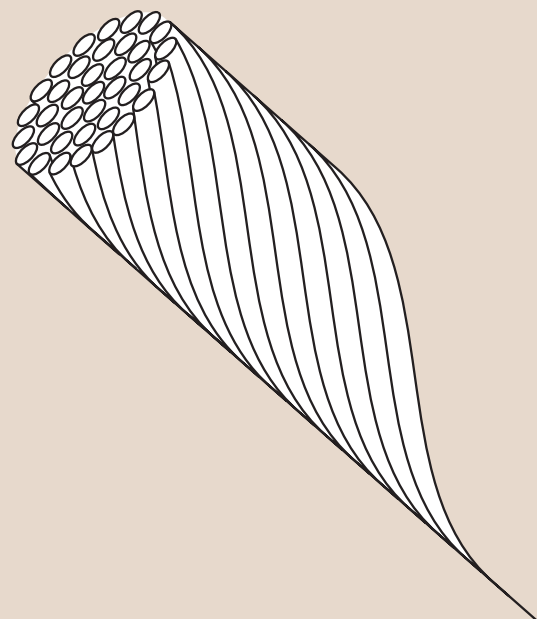
the use of continuous filaments, high strength, abrasion resistance and a more even thread character than spun threads. They are also ideal for use as embroidery threads when made from trilobal polyester or viscose which offer the high level of gloss required.

Monofilament – as the name implies, these consist of a single filament of polyester or polyamide extruded through a single-jet nozzle. They are normally transparent and tend to be comparably hard and stiff, with a shimmering glossy look and a smooth surface. Their use in footwear is relatively low.

Sewing and sewing threads are likely to remain a major part of the shoemaking process for the foreseeable future. The seams of an upper not only hold it together but are frequently also an essential part of the overall design. They are almost the first thing anyone looks at, so poor seams and stitching can ruin a shoe just as good seams and stitching can help to make it. It is wise to take the utmost care in this key part of the shoemaking process. 🧵

Part 2 will appear in the July/August issue of World Footwear and will cover needles and the types of seam they produce.

Figure 11 – Multifilament thread



CREDITS: FIGURE 6-11: AMMAN GROUP