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Threads, needles and seams

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Sitching forms a vital part of the construction of most footwear and threads are therefore a key component. Seam strength, however, does not just depend on the sewing thread used but a combination of a number of factors. Sewing threads are nevertheless critical to producing a strong and durable seam, and it is not just the size of thread which needs to be considered. Other factors are the yarn type and the actual thread construction. The three most common types of upper closing threads in use today are nylon, polyester and polyester/cotton cospun. This applies only to functional, load-bearing seams, not decorative or embroidery stitching, where other types may be used.

Nylon threads are commonly twisted two- or three-ply (depending on their size) continuous filament nylon 6.6.

These are usually bonded or lubricated. Twisted monocord threads have been used in bobbins for some time and their use as needle threads has recently become more prevalent.

Polyester threads are normally supplied as lubricated, continuous filament (CF), twisted or, for heavier applications, plaited or braided types. Bonded CF polyester threads are also

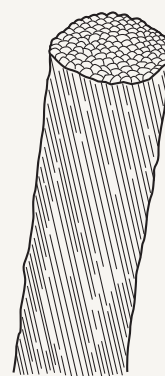
THREAD TYPES



Continuous filament (bonded)



Cospun



Monocord

THREAD TWISTS

Left or Z-twist



Right or S-twist



available, although less common than nylon. Staple (or spun) polyester fibre threads, which are produced using short lengths of yarn rather than continuous filaments, are little used in the footwear industry due to their inferior strength.

Corespun threads comprise a continuous filament core, usually polyester, with a staple cotton sheath. Although some types have a staple polyester fibre sheath, these are not common in the footwear industry. Corespun threads benefit from the heat resistance and 'natural' look of the cotton sheath while still retaining good strength properties due to the polyester CF core.

Whatever the fibre type, most footwear threads are produced by twisting together two or three separate cords. Control over the degree of twist used is essential as threads with too little twist will be prone to fraying, breakage and poor control during sewing. Those with too much twist will have a tendency to knot and twist (this is sometimes referred to as 'twist liveliness') especially around the machine thread guides.

A further factor which needs consideration is the direction of twist. Threads can be twisted in a 'left-handed' direction (known as Z-twist) or 'right-handed' (S-twist). Z-twist threads are most common in lockstitch machines, while S-twist threads are designed for specialist applications such as twin-needle machines where opposite twists are required to balance the direction of loop formation during stitching.

THREAD SIZE

Although the strength of the thread is directly proportional to its size (or weight), this is not the only critical

factor in producing stronger seams, as will be discussed later. However, for a given seam, if the thread is below a minimum size then the seam will never perform satisfactorily, whatever the other factors involved.

The most straightforward system for sizing threads is the tex system. This is based on linear density and tex value is defined as the weight in grams of 1,000 metres (1 kilometre) of thread. This is easily understood and can apply to any thread. For synthetic fibre threads, however, most thread manufacturers and footwear manufacturers refer to the 'metric ticket number' (Nm) system. This is based on the tex of a thread and assigns ticket numbers to specific ranges of tex values. However, as it is calculated by dividing a length over a weight, this means that the lighter the thread, the higher the ticket number and the heavier the thread, the lower the ticket number. The most common ticket numbers used as upper closing threads are as follows.

Nylon	Polyester & corespun
20	18
40	36
60	50

Nylon threads are usually slightly stronger than equivalent-size polyesters, but this difference is not significant. Although corespun threads are of the order of 20% weaker in the unsewn state, there is evidence that they suffer less weakening due to frictional heat effects during the sewing operation and may therefore end up with similar strengths as CF threads once seamed.

NEEDLE TYPE

Needles play a critical part in determining both the appearance and the performance of the finished seam. The type of needle must first be chosen to achieve the desired appearance. There are two main classes of needles: round point, also known as cloth or ball point, and cutting point, also known as leather point.

Round point needles are best suited to fabrics as they are designed to push aside yarns and fibres rather than to cut through them and are therefore less likely to damage the weave or knit structure. However, if used on denser materials such as leather, the high friction generated as they puncture the material can cause significant thread damage. Their use in leather products is therefore restricted to thin, lightweight leathers only. Round point needles can also be used on coated fabrics, although the plastic coating used can also lead to friction problems. The puncture hole in thin coatings can also be unsightly in the finished seam.

Cutting points have blade-like tips which can more efficiently cut through thicker leathers with minimum friction. As they cut the fibres in the materials being stitched, the most common type used is known as the 'narrow-wedge' type, which produces a cut perpendicular to the direction of stitching. This means that there is minimum damage to the fibres lying across the seam, maximising the strength of the finished seam. The narrow wedge needle gives distinctive 'off-set' or 'slanted' stitches.

Triangular tip needles are sometimes used where a straight stitch line is required. However, these cause more damage to the fibres across the seam and they need to be used with caution. A variation of this type of needle is the 'tri-R' type which is essentially a round point needle with a small triangular tip. This can significantly reduce the friction of the initial puncture yet cause less damage to the fibre structure than full a triangular tip. This type is therefore well suited to coated fabrics and light leathers. Common manufacturers' codes for these needles are as follows.

Narrow wedge	Coded NW or P
Round	Coded R
Triangular	Coded D or TRI
Tri-R	Coded SD

NEEDLE SIZE

It is essential that the size of the needle matches the thread being used, the size of which must first be chosen to suit the seam. A needle's size is usually marked on its shank. This is the widest part at the end of the needle which is used to clamp it in the stitching machine. Two main needle sizing systems are in use, metric and the Singer system, with metric the most commonly used today.

With both of these systems, the higher the number, the larger the diameter of the needle. The metric size is a direct measure (in hundredths of a millimetre) of the diameter of the 'blade', which is the main stem of the needle above the eye before it thickens into the shank. A needle with a blade diameter of 1mm is therefore designated as size 100. The Singer size is based on an arbitrary coding system which has no direct correlation to any needle dimension. Recommended needle sizes for the common thread sizes are as follows.

Thread ticket number	Needle size (metric)	Needle size (Singer)
20/18	110-120	18-20
40/36	100-110	16-18
60/50	90-100	14-16

SEAM CONSTRUCTIONS

First of all, there are two principal types of stitching: lockstitch and chainstitch. In upper closing, the most important is lockstitch, where the needle and bobbin threads are 'locked' together within the material. This produces the strongest and most stable

seams. Chainstitch is not to be recommended for functional seams in uppers as it is less strong and prone to unravelling if one end becomes damaged or undone. This type is usually confined to linings where durability is less important.

With lockstitch machines, the tensions in both the needle and bobbin threads are critical to effective locking of the threads in each stitch. Incorrect tensioning of one thread will draw the lock point towards one surface of the material. The closer the lock point to the material surface, the more easily can the thread be pulled from the seam and therefore the less stable it will be.

With respect to seam types, three basic seams are used in footwear uppers: lapped, closed and butt. The one most commonly used is the lapped seam, where one upper component is laid over the other. This usually means that the raw edge of the upper material is visible in the finished shoe. This may be undesirable particularly if the material is susceptible to fraying, as in fabric uppers.

The closed seam is where the upper components to be joined are laid face-to-face and a seam applied along one edge. When the two components are opened out after sewing the raw edges of the upper material are then hidden. After opening out, the raw edges are usually rubbed down (flattened) to avoid discomfort in wear.

The butt seam is where two components are laid edge-to-edge (abutted). As this type of seam is neither strong nor attractive, it tends to be used where the join is to be reinforced or covered by a third component. Common applications include backseams that are to be covered by a back strap or counter and in linings, where their relative flatness helps to minimise the risk of the seam rubbing on the foot. A zig-zag type of lockstitch is used to produce them.

SEAM DESIGN

Once the type of thread, needle and seam construction is agreed, there are still many parameters to be decided which will critically affect the strength and durability of the finished seam.

The distance of the stitching from the edge of the component (i.e. the edge

STITCH TENSION

Correct



Lock buried in material

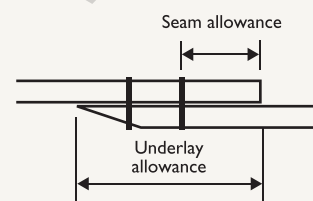
Incorrect



Lock showing on underside of material

SEAM TYPES

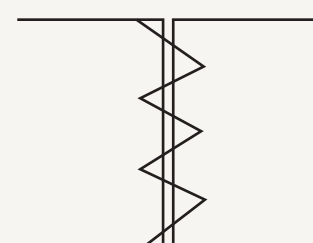
Lapped seam



Closed seam

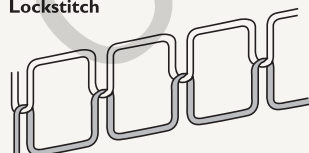


Butt seam

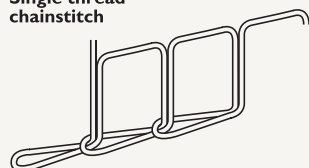


STITCHING TYPES

Lockstitch



Single thread chainstitch



distance or seam allowance) is critical to both the appearance and the performance of the finished seam, although this is less so with butt seams. Too narrow an edge distance can lead to material failure, while too wide an allowance can cause the upper to rub on the foot in wear. The precise allowance should be chosen according to the type and thickness of the upper material being sewn. Where one of both

of the materials are relatively thick, reducing their edge thicknesses by skiving may be necessary. Where materials are thin or weak, a reinforcement of one or both must be considered. This may take the form of overall reinforcement or local reinforcement at and in the vicinity of the seam.

After size and strength of the thread, perhaps the next most important contributor to final seam strength is the number of stitches per unit length of seam, known as the 'stitch density'. The more stitches there are in a given length of seam, the stronger it will be. Doubling the stitch density will effectively double the seam strength. However, there is a maximum density above which the stitch holes are so close together they merge and the material tears easily (known as the postage stamp effect). This maximum level will depend on the thread and needle sizes chosen. Another method of increasing seam strength is to add additional stitch rows as two identical seams will double the overall strength.

STITCHING QUALITY

There are two equally important factors in determining quality of stitching: the machine and the operative. Both require careful attention. The speed settings and the thread tensioning mechanisms of the machine must be correctly set for the types of stitching required. The positions of the controls are also important for ease and comfort of operation.

The operative's training will clearly be a factor in the quality of the work but this should not be confined only to the actual stitching operation. How the operative is seated in relation to the machine controls and the work piece is equally important as uncomfortable or fatigued workers will stitch neither well nor efficiently.

Operative training must also include the importance of regular needle changes as many materials will cause wear of the needle points which can quickly become blunted. These will then produce poor quality stitching and also cause more friction and heat damage to threads, producing weaker seams.

QUALITY CONTROL

Whatever the stitching operation, process monitoring in the factory is essential to ensure that all work is being progressed exactly as specified with respect to all the factors described in this article.

The final step in any quality control programme is testing the final product. As seam failure is consistently one of the most common causes of customer returns, testing the final seams is critical to ensuring ongoing quality and consistency.

There are many tests which can be conducted on threads and seams and the best combination will depend upon the footwear being manufactured and the type and position of the seam in the upper.

SATRA has developed comprehensive recommendations for threads, needles and seam constructions for use in various parts of all types of footwear types and is able to advise on the tests best suited to the materials, constructions and final products involved. 



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