Seam Engineering

One of the forgotten elements in sewing manufacturing is seam engineering. For example, a typical pair of branded five pocket jeans retailing for $30 to $75 is sewn with approximately 250 yards (200 meters) of thread. The cost of a quality thread for these jeans is approximately $0.25 U.S. per garment. Many jean manufacturers will spend anywhere from $1 to $6 per jean to have them stone washed, acid washed, or sandblasted. Incredibly, the thread is expected to hold the seams together for the life of the garment regardless of what abuse it has been exposed to! In such cases, what some forget is that…

> ***Though thread makes up a small percent of the cost of the garment, it shares 50% of the responsibility of seam quality***.

If a manufacturer has frequently returned garments for excessive seam *"unqualities,"* such as, re-stitched seams or seam failure due to the thread rupturing, we would say the garment is "under-threaded," meaning that either the wrong type or size of thread is being used. Quality seam engineering relates to many areas of concern including **seam strength** and **seam durability**. Obviously thread plays an important role in all of these areas that are controlled by the factors described below.

> **Note:** For additional information, refer to *A&E's Thread Selection Guides by Application* to determine the correct thread type and size generally used for quality seams. See the **Technical Information** section of our web site: *http://www.amefird.com*

Seam Engineering – Thread Size

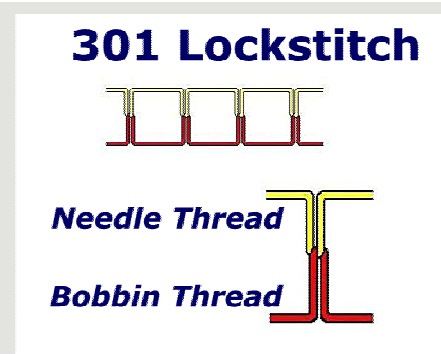
We are frequently asked by sewing factories if they should use the same size thread throughout the sewn product or if they could save money by using a smaller thread size on the underside of the seam or in overedge seams. Before these questions can be answered, the manufacturer should first take into consideration:

- The number of colors that will be sewn in a season.
- If it is even feasible to use more than one thread size.

If you are sewing childrenswear or womenswear where there are always many colors being sewn at any one time, then we would recommend staying with the same type and size of thread throughout the garment. On the other hand, if you are sewing products that consist of several basic colors, the best option is to use smaller threads on the inside of the garment to significantly reduce the thread cost.

Another factor that should be considered is the affect that this downsizing of thread will have on your seam strength. Following are some common-sense "rules of thumb" for thread size selection on seams sewn with 301 lockstitch, 401 chainstitch, and 504 overedge.

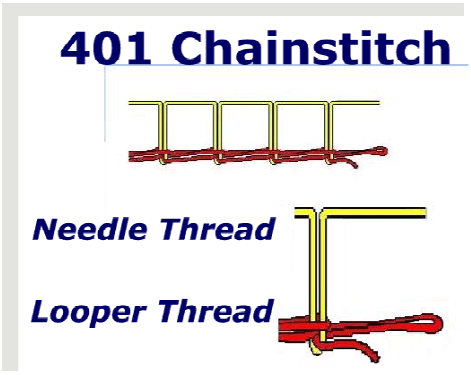
301 Lockstitch Seams



For 301 lockstitch seams, we generally recommend using the same needle thread size as the bobbin thread size in the seam. Why? Because *"a chain is only as strong as its weakest link."* If a smaller, weaker thread is used in the bobbin, then the seam will only be as strong as the bobbin thread. This is particularly true with lockstitch seams because of the way the needle and bobbin threads are interlocked together.

In some cases though, this does have exceptions. Sometimes a smaller size thread with a different fiber type and/or thread construction can be used and still maintain seam performance. An example would be to use a higher tenacity *Corespun* in place of a *Spun* thread. To take this a step further, you can use an Anecord *Nylon,* monocord bobbin instead of a spun or corespun thread in the seam. Also, exceptions can be made when a larger topstitching thread is desired to give a bold appearance on the outside of the garment when it is not necessarily being used to add strength or durability to the seam.

401 Chainstitch Seams



Notice that in the diagram of the 401 chainstitch, a loop of looper thread is holding the needle thread through the seam. Also, notice that the threads are interlooped rather than interlocked as we saw on the lockstitch seam. This allows a looper thread to be downsized to at least 60% of the needle thread size without adversely affecting the seam strength (for example: T-60 needle thread – T-40 looper thread). This is one way to reduce thread cost without adversely affecting the seam quality. However, you need to determine if carrying another SKU (stock keeping unit) will significantly increase the cost of inventory and supervision on the sewing floor to make sure the right size thread is being used in the correct position.

504 Overedge Seams

504 Overedge seams have basically the same needle thread formation as the needle thread on a 401 chainstitch seam. Therefore, the same rule applies. You can use a looper thread approximately 60% of the needle thread size without adversely affecting the seam strength (for example: T-24 needle thread – T-18 looper threads). Just remember that smaller looper threads will not give the seam coverage of larger thread sizes.

Factors that Affect Seam Strength

Five factors that determine the strength of a seam include:

- Fabric type and weight.
- Thread fiber type, construction, and size.
- Stitch and seam construction.
- Stitches per inch.
- Stitch balance.

Any one of these factors can adversely affect the performance of a sewn product depending on the end-use of the sewn product. Following are a few general comments related to the factors listed above.

> **Note:** Technical bulletins focused on optimizing seam performance when sewing denim or when sewing stretch knits are available through A&E. Refer to the **Technical Information** section of our web site: *http://www.amefird.com*

Fabric Type and Weight

Fabric type and weight can affect seam performance depending on the following:

- Fiber content (100% cotton, cotton/polyester blend, nylon).
- Fabric construction:
  - Woven or knit.
  - Type of weave used (plain, twill, jersey, tricot).
  - Fill count.
  - Yarn type and size.
- Pattern placement and seam direction.
- Propensity of the yarns in the seam to shift or pull out of the seam.

When engineering seams, we recommend doing tensile tests on the fabric to determine its strength. You cannot specify seam strength requirements that are stronger than the fabric itself.

Thread Fiber Type, Construction, and Size

These all have a definite effect on seam strength including the following factors:

- **Fiber Type:**
  - Some fibers are stronger than others and have greater loop strength contributing to greater seam strength. For example, a 100% spun polyester thread will give greater seam strength than a 100% cotton thread of the same size.
  - Synthetic fibers like polyester and nylon are much more resistant to abrasion and chemical degradation (such as bleach) than cellulosic fibers. Cellulosic fibers on the other hand have superior heat resistance.
  - Kevlar® and Nomex® threads were designed to resist high temperatures in protective clothing.

- **Thread Construction (Spun, Core, Textured, Multifilament, etc.):**
  - Core threads, made with a continuous filament polyester core, generally will provide higher seam strength than spun and textured threads.
  - Continuous filament polyester or nylon thread constructions will provide greater resistance to abrasion and seam degradation.
  - Some thread constructions are less subject to shearing or cutting each other when interlooped together in the seam. Air entangled, textured, and monocord thread constructions exhibit the best loop strength characteristics.

- **Thread Finish (Soft, Mercerized, Glaced, Bonded, Etc.):**
  - Glace or bond finished threads generally have superior abrasion resistance to soft finished threads.
  - Mercerized threads are stronger than soft cotton threads of the same fiber type and size.

- **Thread Size (Tex, Metric, Yarn Size):**
  - Given a specific fiber type and thread construction, the larger the thread size, the greater the seam strength. As previously mentioned, different fiber types and thread constructions have different loop-strength characteristics. In many cases, a smaller thread size will imbed itself in the seam making it less prone to surface abrasion.

Stitch and Seam Construction

- **Stitch Types:**
  - Generally, the more thread consumed in a stitch, the greater the seam strength. This holds true when comparing 301 lockstitch seams to 401 chainstitch seams.
  - Threads used in 301 lockstitch seams are more susceptible to shearing each other than 401 chainstitch and 504 overedge seams because of the way the threads are interlocked together rather than interlooped together.

- **Seam Types:**
  - Many seam constructions are more resistant to both stress and abrasion than other constructions. For example, a *Fed. Spec 751a 'LSc'* or *ISO 4916 2.04.06* felled seam is the strongest of all seams because the stress is shared by the fabric and the thread.

Stitches per Inch

- Generally, the greater the number of stitches per inch in a seam, the greater the seam strength. This refers back to the point that the more thread you put in the seam, the stronger the seam. However, on some fabrics, too many stitches can cause damage to the fabric by cutting the yarns enough to weaken it.
- Excessive stitches per inch can also contribute to seam puckering and reduce the speed through the machine resulting in loss of production.

Stitch Balance

- As a rule, the more needle thread that can be put into a seam, the greater the seam strength. This can be accomplished by adjusting the sewing machine thread tensions, thread control guides, and eyelets, etc.
- Care should be taken not to put too much needle thread in the seam to cause the seam to "grin" or open up when stress is applied to it.
- Excessive sewing machine thread tension will cause reduced seam strength as well as create other sewing problems.

Estimating Seam Strength on Wovens

Below are two formulas that were developed for estimating the seam strength on woven fabrics. To do the calculations, you need to know the following:

- **Stitch type** (301 Lockstitch or 401 Chainstitch)
- **Thread Strength** (Single-end breaking strength of the thread, measured in pounds)
- **Stitches per inch**

301 Lockstitch Formula	401 Chainstitch Formula
SPI X THD. Strength X 1.5* = Estimated Seam Strength For example: 10 X 4.0 lbs. X 1.5 = 60 lbs. * Factor based on normal loop strength of threads used for apparel.	SPI X THD. Strength X 1.7* = Estimated Seam Strength For example: 10 X 4.0 lbs. X 1.7 = 68 lbs. * Factor based on normal loop strength of threads using double loop on underside.

Abrasion Resistance

Abrasion resistance has always been an important factor to upholstery, footwear, and carpet manufacturers. Recently, abrasion resistance has also become important in apparel due to the stringent laundering cycles and pre-wash processes used in garment preparation. Factors that affect the abrasion resistance of a sewing thread in a seam include:

- Fiber Type (nylon, polyester, cotton, etc.).
- Fiber size and shape (denier per fil, round, trilobal, etc.).
- Thread construction (monocord, corespun, spun, air entangled, etc.).
- Thread size.
- Stitch and seam construction.

Currently, no ASTM, AATCC, or ISO abrasion test exists for evaluating the toughness of sewing threads. However, A&E conducted comprehensive tests using a modified crockometer to achieve the following results.

Thread Type / A&E Brand	Tex Size	Rating
100% Soft Cotton: Anecot™	T-50	2
Glaced Cotton: Anecot Glaced™	T-60	4
Textured Polyester: Wildcat Plus™	T-35	4
Spun Polyester: Perma Spun™	T-60	5
Core (Cotton Wrapped): D-Core™	T-60	6
Core (Polyester Wrapped): Perma Core™	T-60	7
Air Entangled Polyester: Magic™	T-60	8
Soft Poly Multi-filament: Anefil Poly STX™	T-45	8
Bonded Poly Multi-filament: Anefil Poly BT™	T-45	9
Bonded Nylon Multi-filament: Anefil Nylon BT™	T-45	10

(Rated on a scale of 1 to 10 with 10 being the best.)