

# SEAM ENGINEERING

## ***FACTORS THAT EFFECT SEAM STRENGTH***

Five factors that determine the strength of a seam include:

- Fabric Type, Weight, Strength, Durability
- Thread Fiber Type, Construction, and Size
- Stitch and Seam Construction
- Stitches Per Inch

Any one of these factors can adversely affect the performance of a sewn product depending on the end-use of the sewn product.

If a manufacturer has frequent complaints from their customers due to seam failures, we would recommend that an evaluation be done to determine if the problem is “thread failure” or “fabric failure”. This can be done easily by seeing if the fabric is still OK but the thread is broken, or observing if the thread is OK but the fabric has failed.

## **FABRIC FAILURE**

If the problem is “fabric failure”, you should determine if the problem is

- “Fabric rupture” or
- “Seam Slippage”

If “Fabric Failure” is occurring due to the yarns in the fabric being ruptured, you can sometimes change the seam design to reduce this problem. This might include:

- Build in more fullness at the location where the seams are failing.
- Add re-enforcements to the seam construction with multiple thicknesses of fabric, etc.
- Reduce the number of SPI if you think that needle penetrations are damaging the fabric. This may require going to a larger and/or stronger thread to minimize the possibility of seam failure due to “thread failure”.



Other potential causes of “Fabric Failure” might include:

- Defective fabric or fabric with low tensile for the application
- Using too large of a needle causing fabric damage
- Fabric or thread degradation

“Seam Slippage” is when the yarns in the fabric are not rupturing, but sliding out of the seam causing the seam to open up. If this is the problem, then we recommend the following:

- Increase the seam allowance or seam margin.
- Re-engineer the seam construction so that all the stress is not trying to separate the warp and filling yarns in the fabric.
- Use a french felled seam construction
- Use a fusible tape on the areas where the seams are failing.
- Contact your fabric supplier for assistance.



If you are sewing homogeneous type fabrics like leather or vinyl, you will not usually have “seam slippage” but the fabric rupturing under extreme stress.

## **THREAD FAILURE**

If the problem you observe is “thread failure”, then you are “under-threaded”. Quality seam engineering relates to many areas of concern including **seam strength** and **seam durability**. Obviously the thread plays an important role in all of these areas that are controlled by the factors shown below.

- Thread Fiber Type
- Thread Construction
- Thread Finish
- Thread Size

For apparel, corespun threads like A&E’s Perma Core<sup>®</sup> and D-Core<sup>®</sup> are the most durable thread constructions. This is due to their corespun construction where approximately 60% of the thread is a continuous filament bundle of polyester fibers. Core threads are recommended for sewing denim, workwear and uniforms, military garments, etc. that will be exposed to demanding finishing or end-use applications.

For most non-apparel sewing applications, a Nylon or Polyester twisted multi-filament thread is recommended include A&E’s Anefil<sup>®</sup> Nylon and Anefil<sup>®</sup> Polyester brands. If abrasion resistance is the primary requirement, we recommend a Nylon thread. If UV and chemical resistance are required, we recommend polyester threads. A&E’s SunStop<sup>®</sup> polyester thread is similar to Anefil<sup>®</sup> Polyester but is made with special UV resistance dyes and finished with a UV inhibitor.

## **THREAD SOLUTIONS**

The threads mentioned above are available either bonded or soft. Most manufacturers use bonded threads in the needle positions because they has superior ply security and sewability.

They are also available in many tex sizes. Generally, the thicker and heavier the fabric, the heavier the thread Tex Size that will be required.

Below are general guidelines for thread sizes being used for non-apparel applications.

|                        |                                          |
|------------------------|------------------------------------------|
| Automotive Seating     | T-70, T-90                               |
| Automotive Restraints  | T-135, T-150 or T-210                    |
| Automotive Air Bags    | T-90, T-135                              |
| Bulk Bags              | T-135, T-210, T-270, T-350               |
| Filtration             | T-90, T-135, T-210, T-350, T-400, T-600  |
| Furniture              | T-70                                     |
| Leather Goods          | T-45, T-70,                              |
| Mattresses             | T-50, T-70                               |
| Outdoor Products       | T-70, T-90, T-135, T-210                 |
| Web Slings & Tie Downs | T-135, T-210, T-270, T-350, T-400, T-600 |

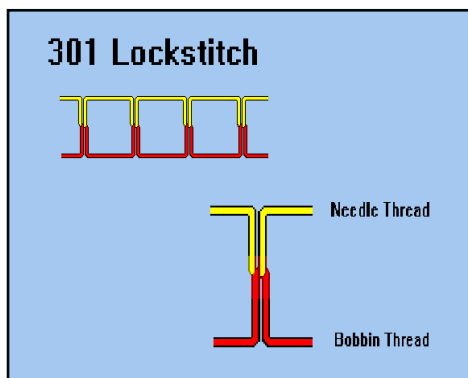
For the exact thread size and type you need, please contact your local A&E Sales, GRS or Technical Solutions representative.

**Remember: Thread makes up a small percent of the cost of the sewn product, but shares 50% of the responsibility of the seam.**

## SEAM ENGINEERING – THREAD SIZE

We are frequently asked what can be done to overcome seam failure due to “thread failure” besides just using a larger stronger thread. Below are rules for seam engineering that should help answer this question.

### 301 Lockstitch Seams



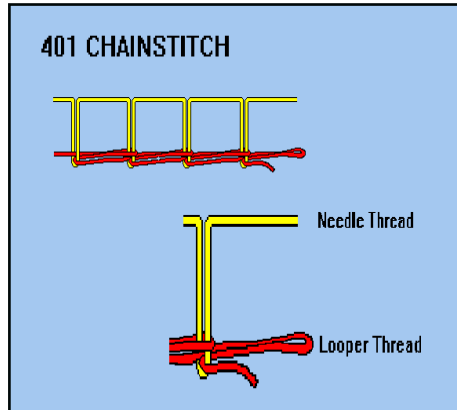
For 301 lockstitch seams, we recommend using the same needle thread size as the bobbin thread size in the seam. Why? Because “a chain is only as strong as its weakest link.” If a smaller, weaker thread is used in the bobbin, then the seam will only be as strong as the bobbin thread.

Many years ago, with 100% cotton threads, a size smaller bobbin thread could be used and still maintain the same seam strength. However, with the introduction of polyester and nylon synthetic fibers that have superior abrasion resistance to cotton, *this rule no longer applies.*

A smaller bobbin thread will allow the sewing operator to wind more thread on the bobbin resulting in fewer bobbin changes and higher productivity. This smaller size thread will also save on thread costs. However, the seam strength is now controlled by the size of the bobbin

thread rather than the needle thread. The result could be an excessive amount of seam failures at some point in the life of the sewn product.

### 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-70 needle thread – T-45 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.

## ESTIMATING SEAM STRENGTH

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                                                                                                                                                                     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>SPI X THD. Strength X 1.5* = Estimated Seam Strength</b></p> <p>For example: 6 X 10 lbs. X 1.5 = 90 lbs.</p> <p>* Based on using the same size threads in the needle and bobbin.</p> | <p><b>SPI X THD. Strength X 1.7* = Estimated Seam Strength</b></p> <p>For example: 6 X 10 lbs. X 1.7 = 102 lbs.</p> <p>* Based on using the same size threads in the needle and looper.</p> |

## 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: <i>Anecot</i>              | 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.)