Sourcing the Best Cotton Products:

Overcoming Shrinkage


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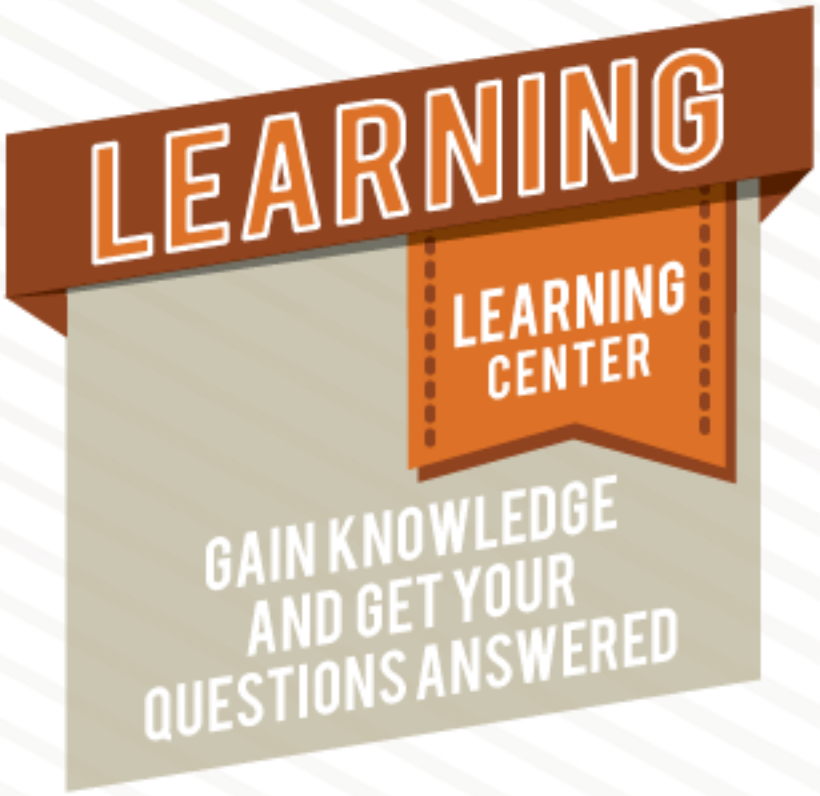

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Hmmmmmm!

There may be *no worse* of an attribute than a shirt, slack, or sheet that shrinks or grows and no longer fits properly.

As a result, a lack of faith in the level of product shrinkage results in the consumer often buying items one size larger and *expecting* they shrink to the correct size.

In today's competitive markets, where high quality is expected at a low price, retail and apparel companies are demanding products with low levels of shrinkage from their suppliers.

Therefore, controlling shrinkage of textile and apparel products is critical to the design and production planning in all areas of the manufacturing supply chain.

As a result, producing low shrinkage in these products adds cost to the textile mill.

In this discussion:

The construction, dyeing and finishing parameters that affect or improve shrinkage are introduced.

Specifically, the impact of fabric density (weight, cover factor, etc.), wet processing techniques, and compaction are included.

In addition, myths concerning the impact of heat on cotton relaxation will be highlighted.

Finally, the effect on production costs will be discussed with regards to producing low shrinkage products.

Shrinkage

One of the most important aspects of an apparel item or home product is its ***dimensional stability*** to laundering.

Dimensional stability is the ***resistance to change*** in the length and width dimensions of a fabric or garment.

Dimensional Change

- In the testing lab, the dimensional change is expressed as a ***percentage*** of the initial dimensions of the specimen.

- In consumer use, the change is a product that does not fit, often to a degree that it is not usable.

Dimensional Change

- Can be a ***growth*** which is an ***increase*** of the length or width dimensions of a specimen, or ***shrinkage*** which is a ***decrease*** of the length or width dimension.

- Some products may ***shrink*** in one direction and ***grow*** in the other.

- The more common dimensional change is that of ***shrinkage***.

What is shrinkage or growth?

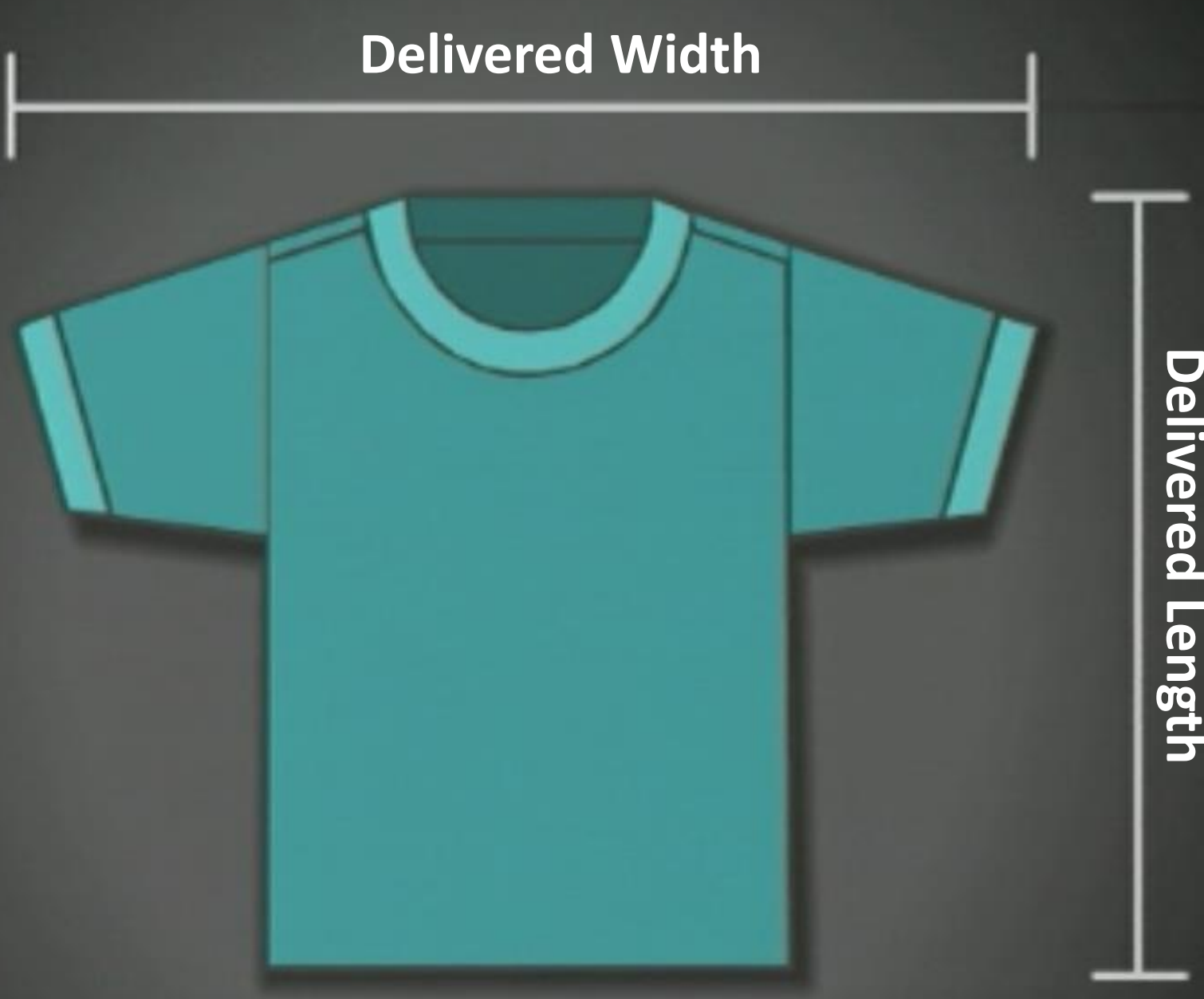
A more appropriate and clear definition of shrinkage or growth to a mill or brand is:

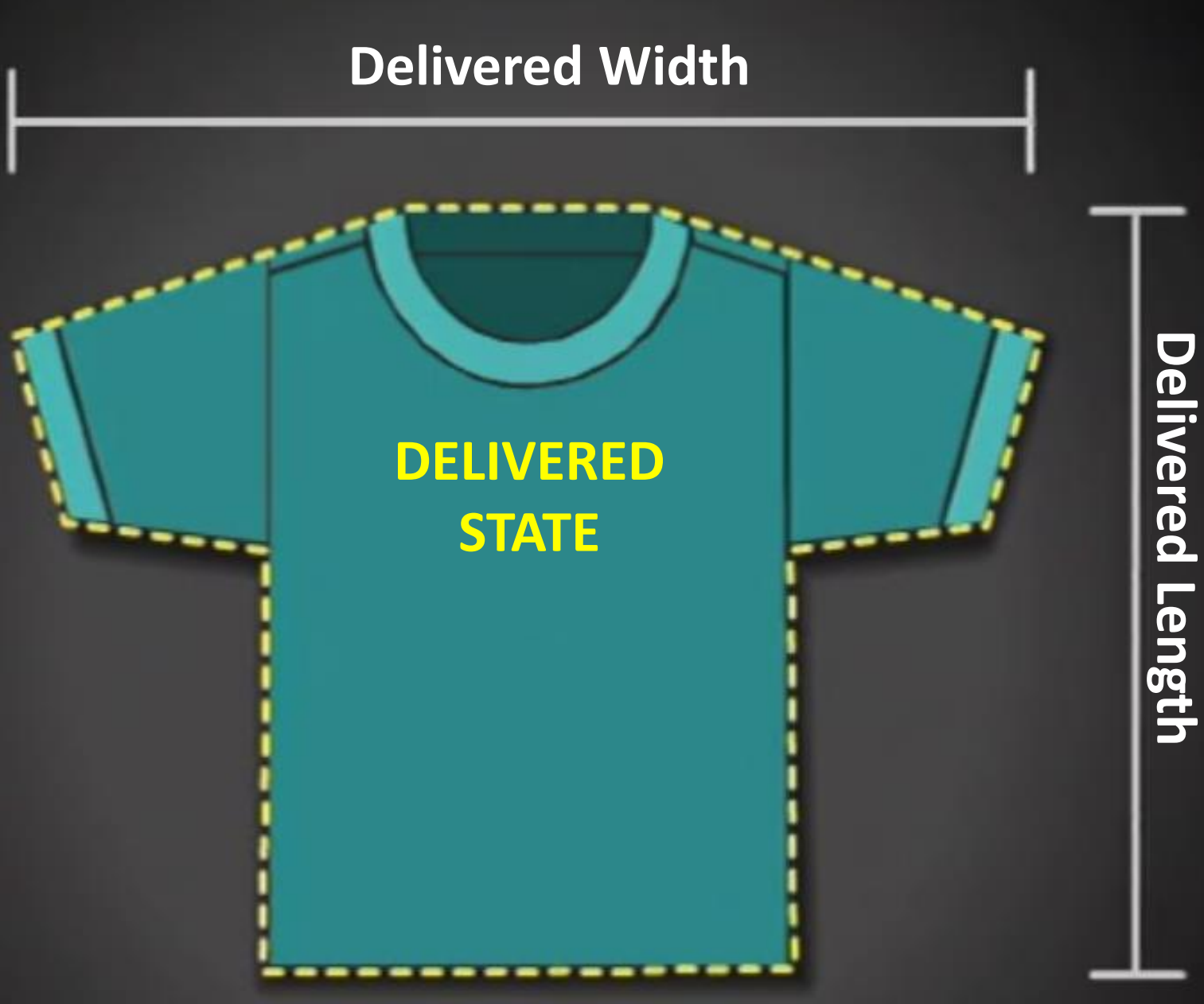
‘The difference in dimensions between the *delivered state* and the *reference state* of a fabric or garment.’

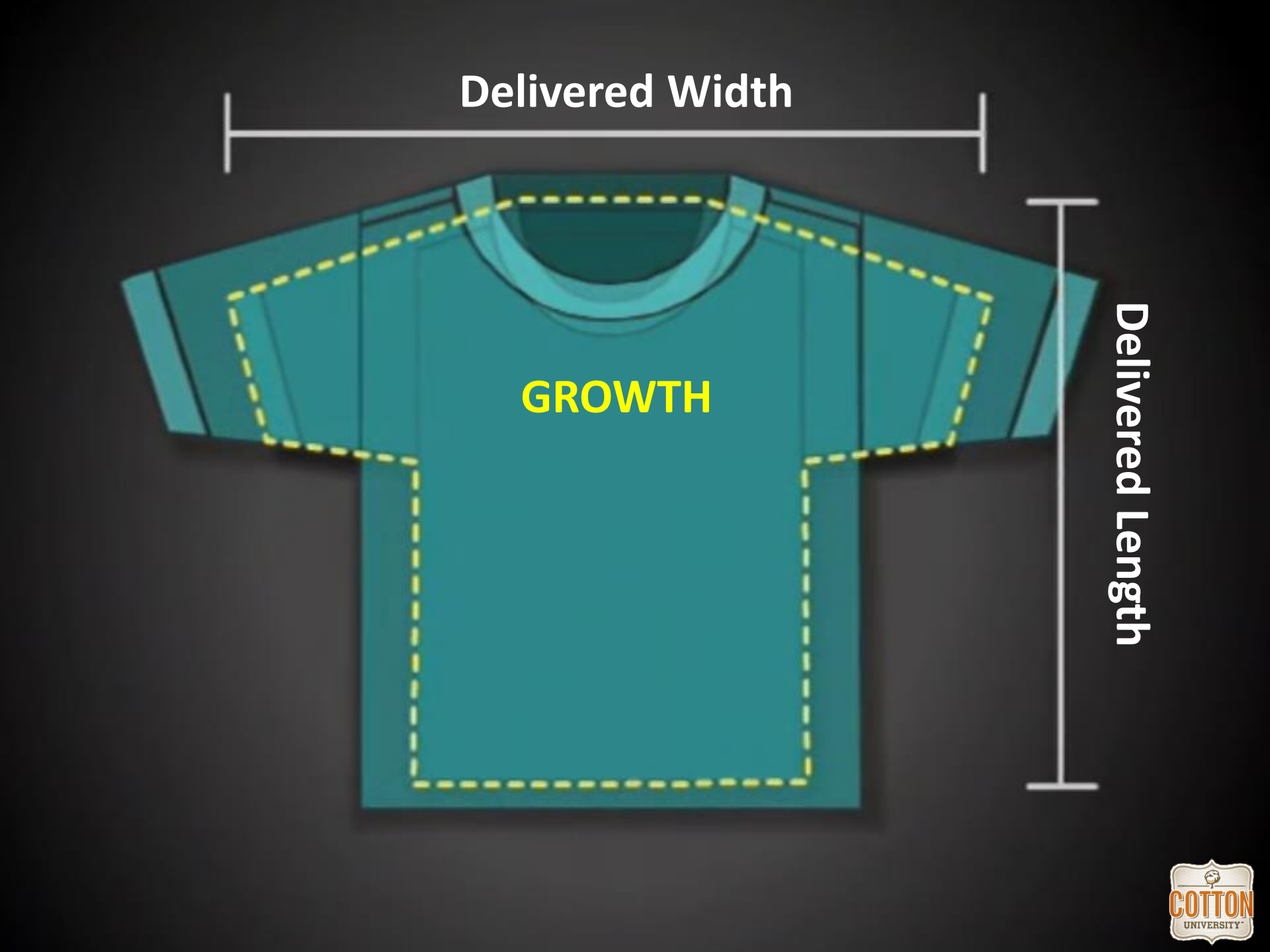
Delivered State

The dimensions or condition of a fabric when ready for use in a textile plant, an apparel manufacturing facility, or at point of sale ***at retail***.

As the product goes through the many processing steps, the delivered state will change.


Delivered Width
Delivered Length


Delivered Width
DELIVERED
STATE
Delivered Length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GROWTH
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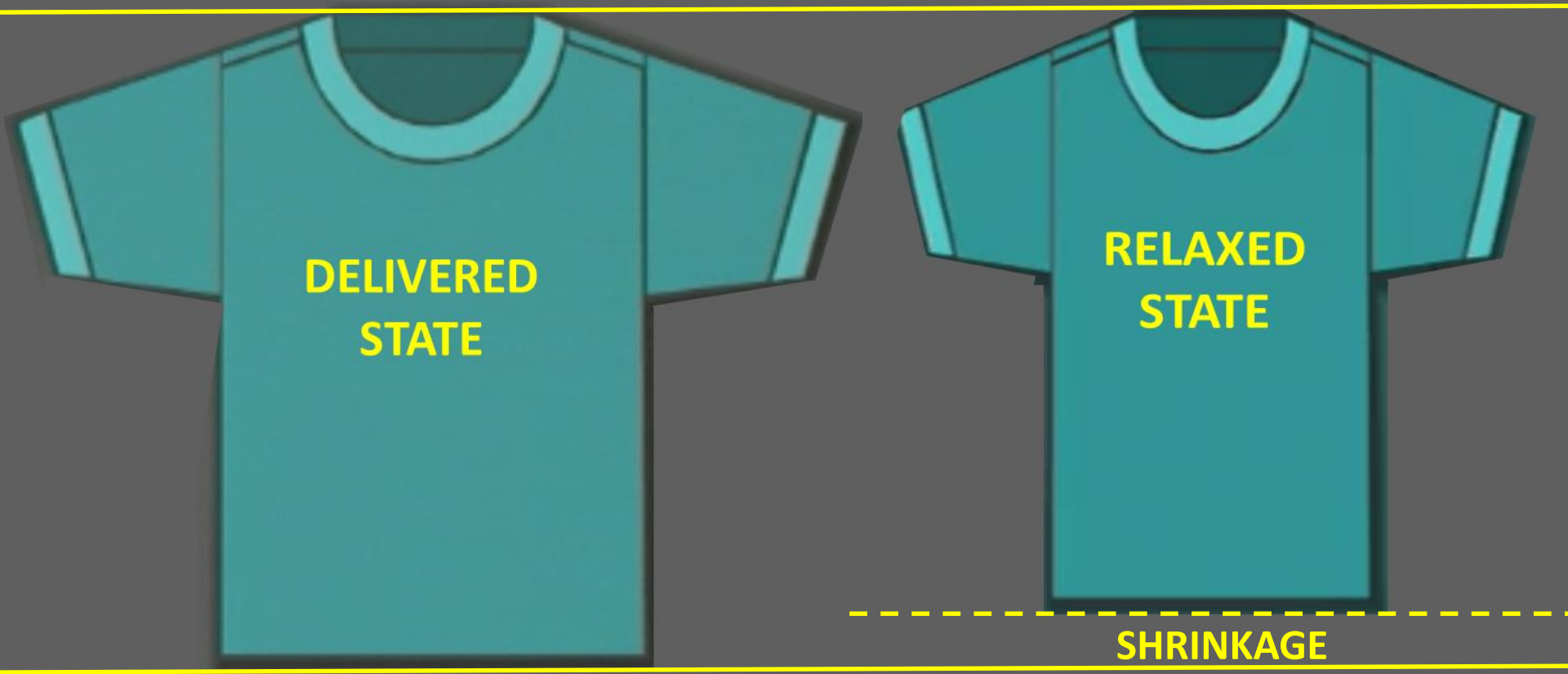
SHRINKAGE

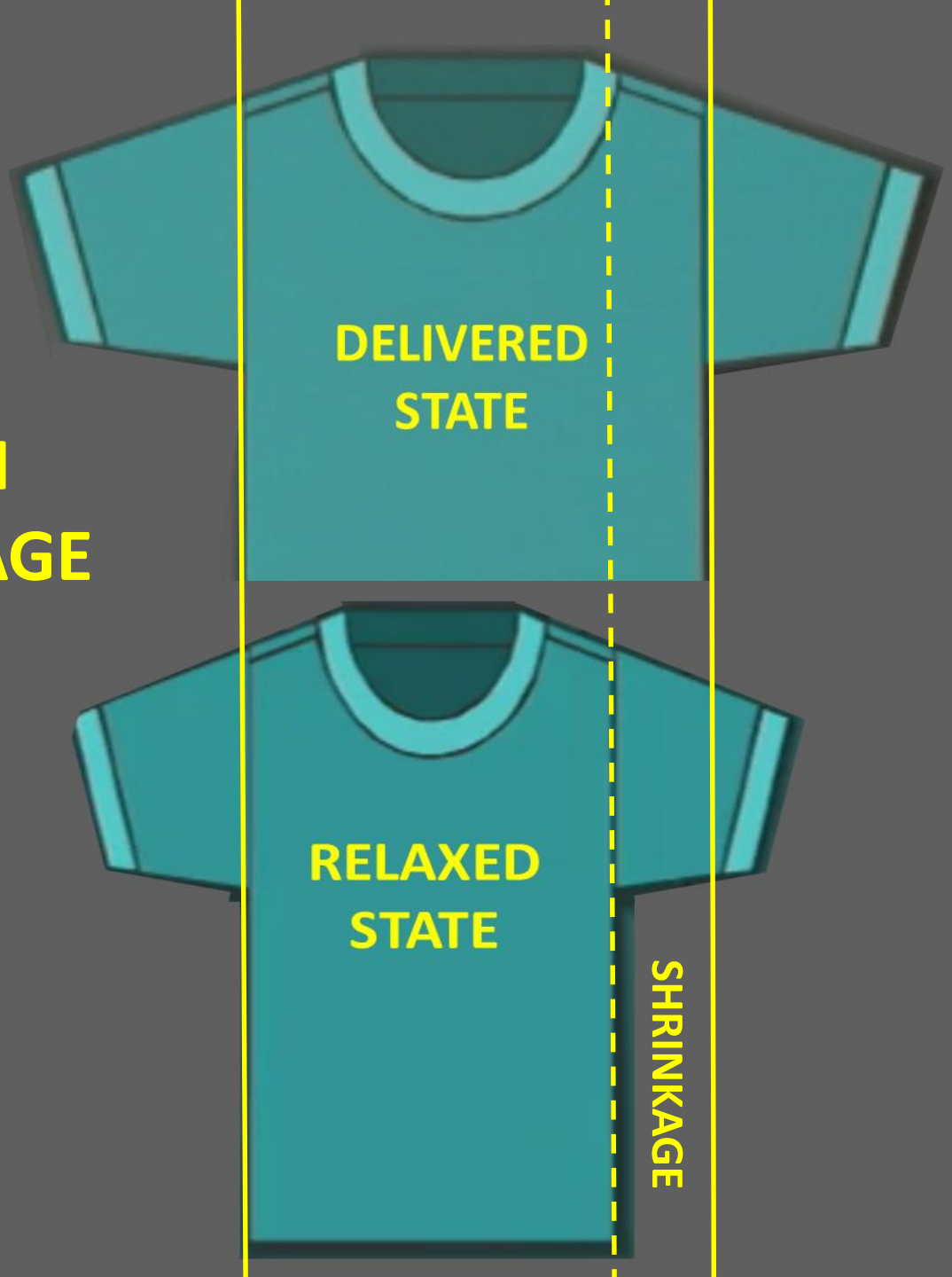

DELIVERED
STATE

LENGTH SHRINKAGE




DELIVERED
STATE

WIDTH SHRINKAGE



Fully Relaxed State

Reference State

The condition of a fabric at which it is completely stable and void of dimensional change.

Also called the fully relaxed state.

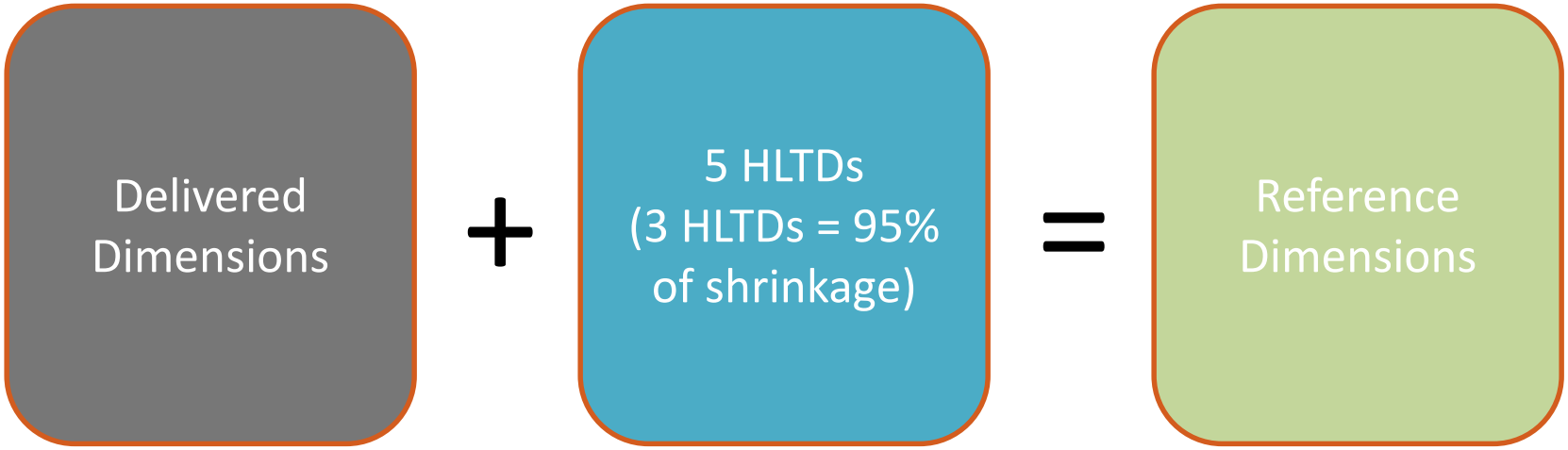
Can be achieved by:

- Mill relaxation drying and/or compaction.

Will be achieved by:

- After repeated cycles of washing and ***tumble drying***.

How to Determine the Reference State of a Product



Why Do Fabrics/Garments Shrink?

To fully understand shrinkage, we must realize that it is the result of..

- ***Construction*** – Fabric Parameters.
- ***Processing*** – Wet and Dry Processing Parameters.

Construction Parameters

Factors Relating to Shrinkage:

• Fibers • Yarns • Machine set-up • Design	Construction
• Wet processes • Finishing procedures • Cut-and-sew techniques	Processing
• Garment care	Consumer

What is the Main Cause of Fabric Shrinkage?

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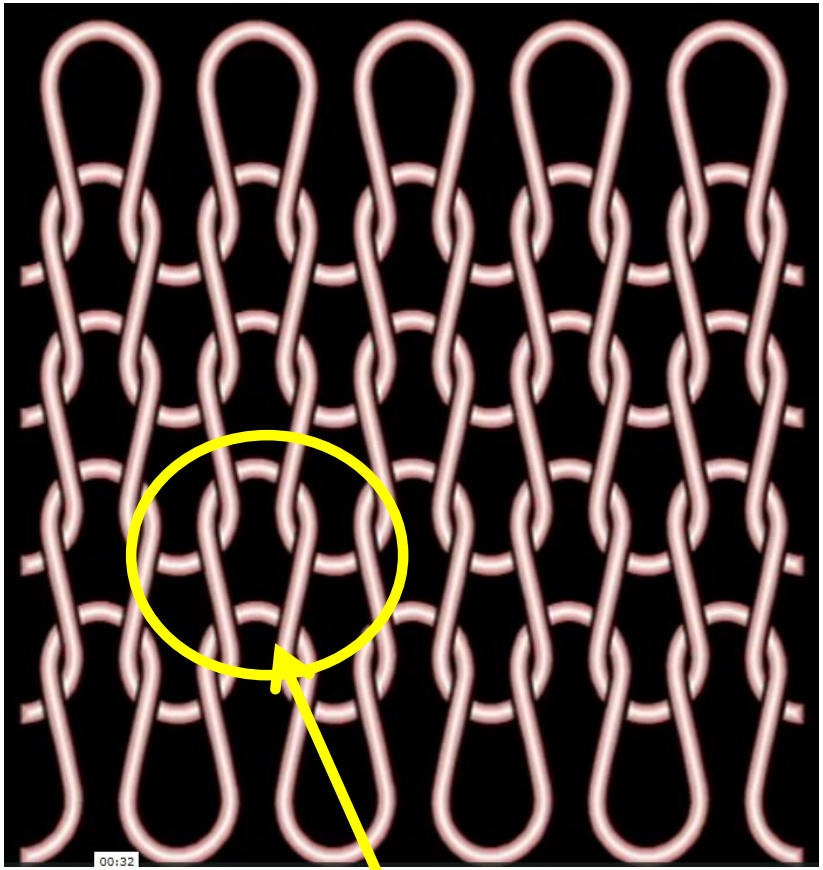
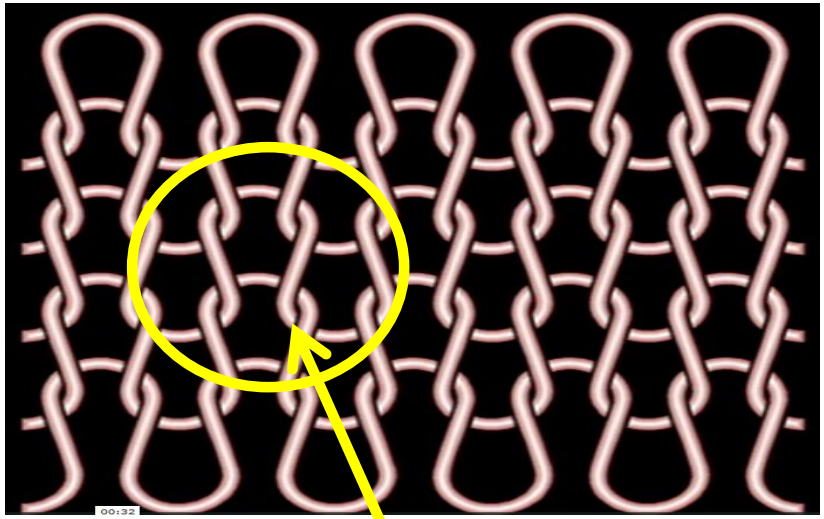
- The techniques used in dyeing and finishing can increase or decrease the stress resulting in shrinkage.
- This openness in the fabric or garment at the consumer level is not permanent (not in the reference state) and is normally removed during laundering.

Delivered Knit Fabric



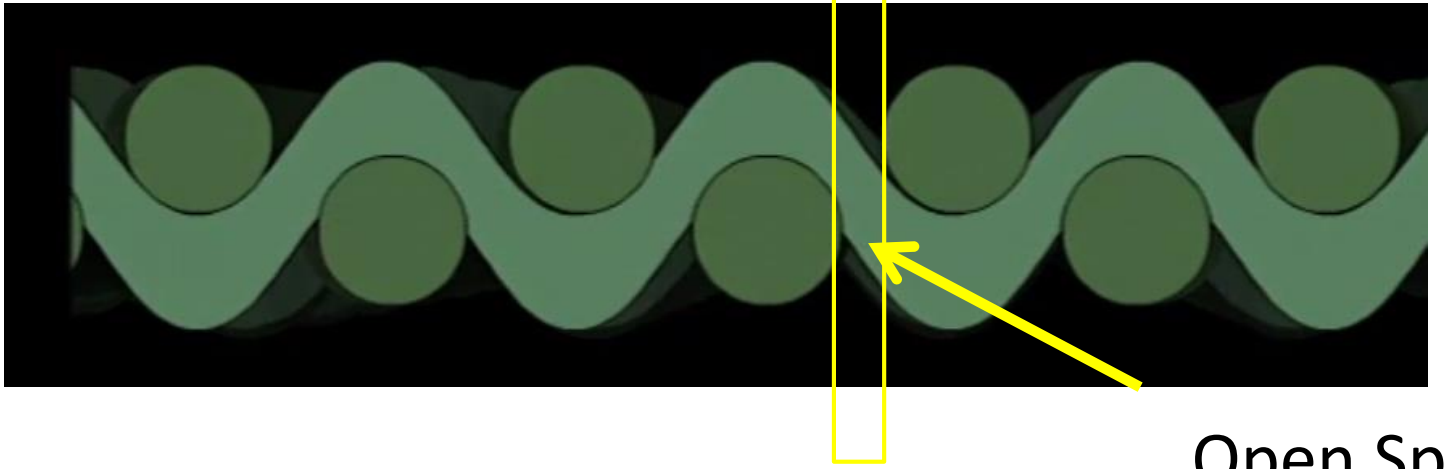
Open & Elongated Loop

Fully Relaxed Fabric

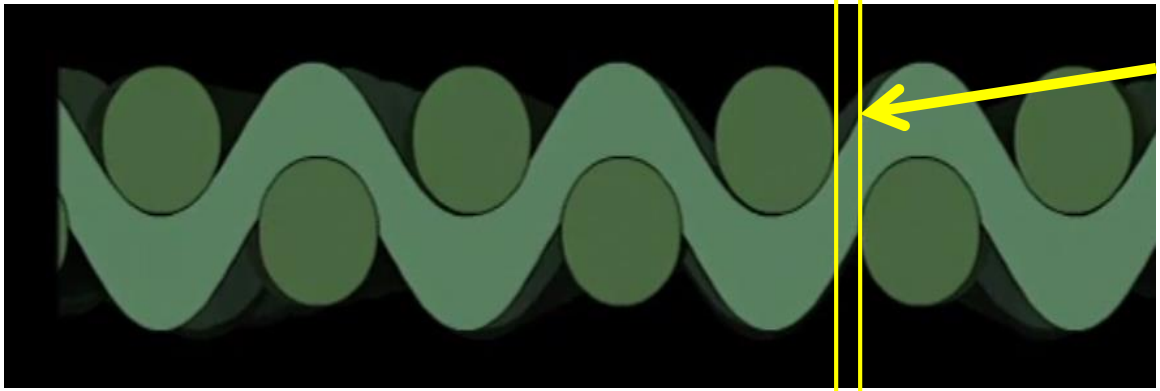


Closed Loop

Delivered Woven Fabric



Open Space

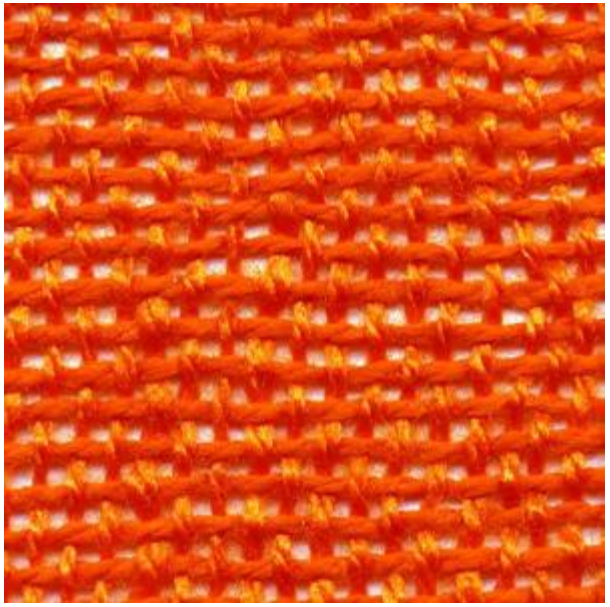


Closed Space

Fully Relaxed Fabric

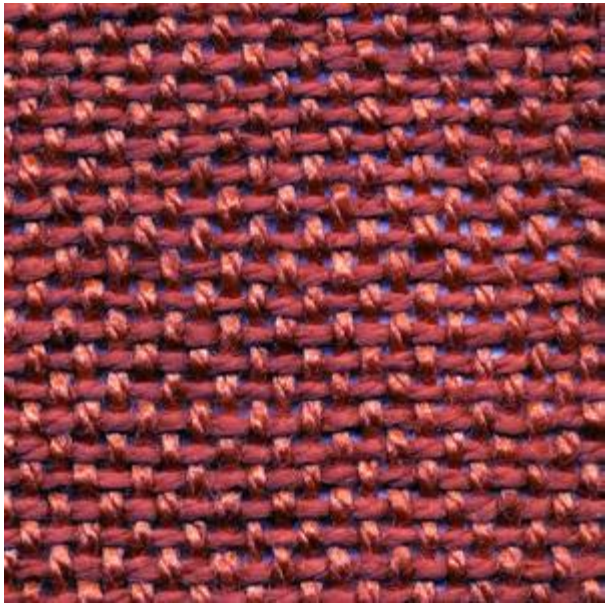
Open Balanced Plain Woven Fabrics

8x8 with 3/2 Yarn Counts



Cover Factor = 13.1

12x12 with 3/2 Yarn Counts

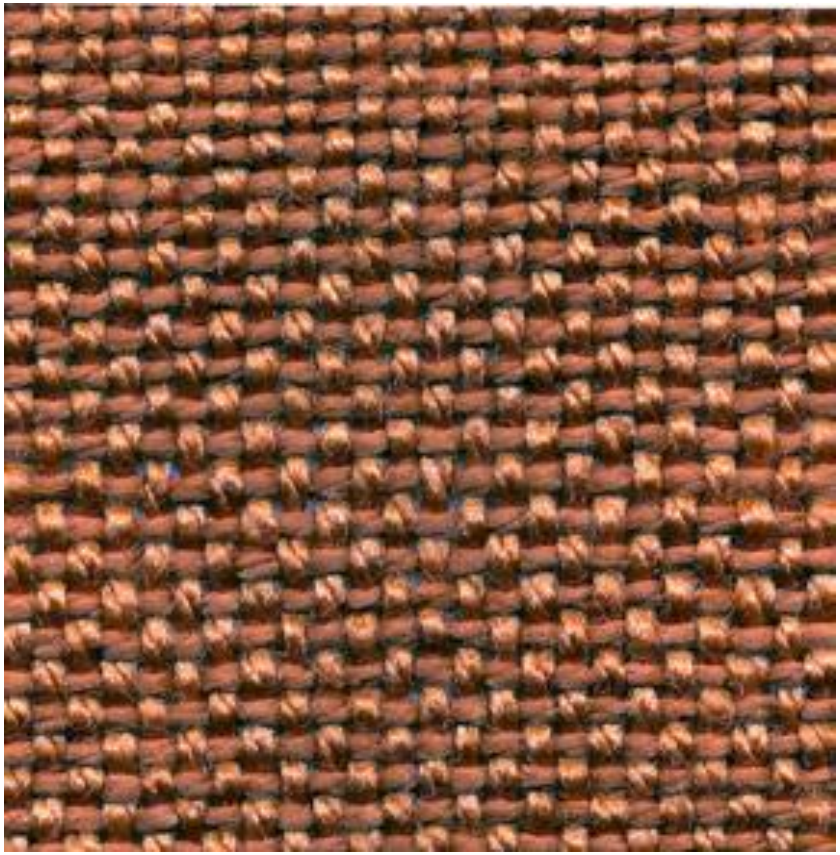


Cover Factor = 19.7

Cover Factor = Ends per Inch/ √Ne

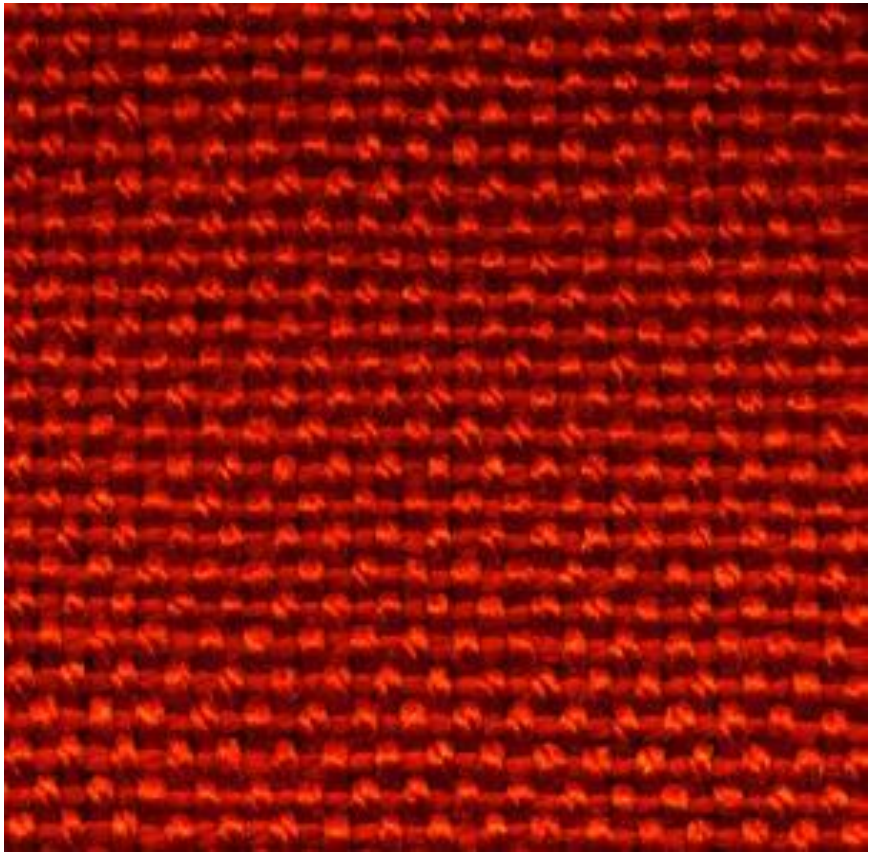
More Dense to Very Dense Construction

14x14 with 3/2 Yarn Counts



Cover Factor = 23.0

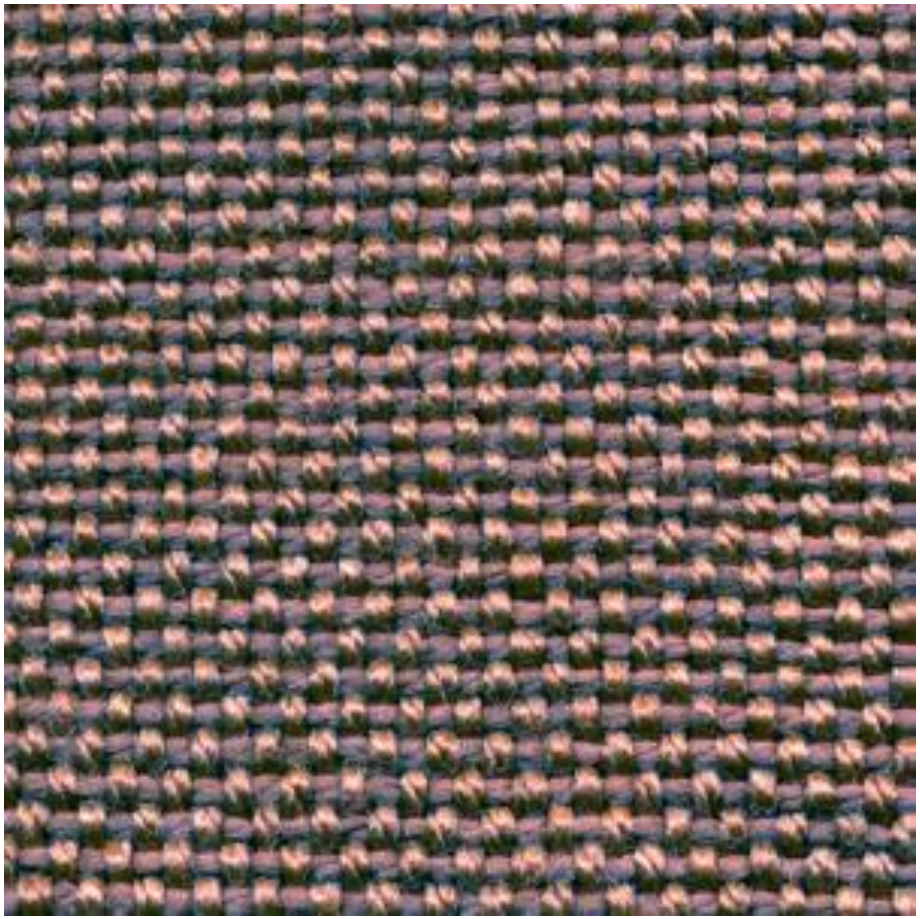
16x16 with 3/2 Yarn Counts



Cover Factor = 26.2

Optimum Weave Construction

15 x 15 with 3/2 Yarn Counts



Cover Factor = 24.6

Manufacturing to Specifications

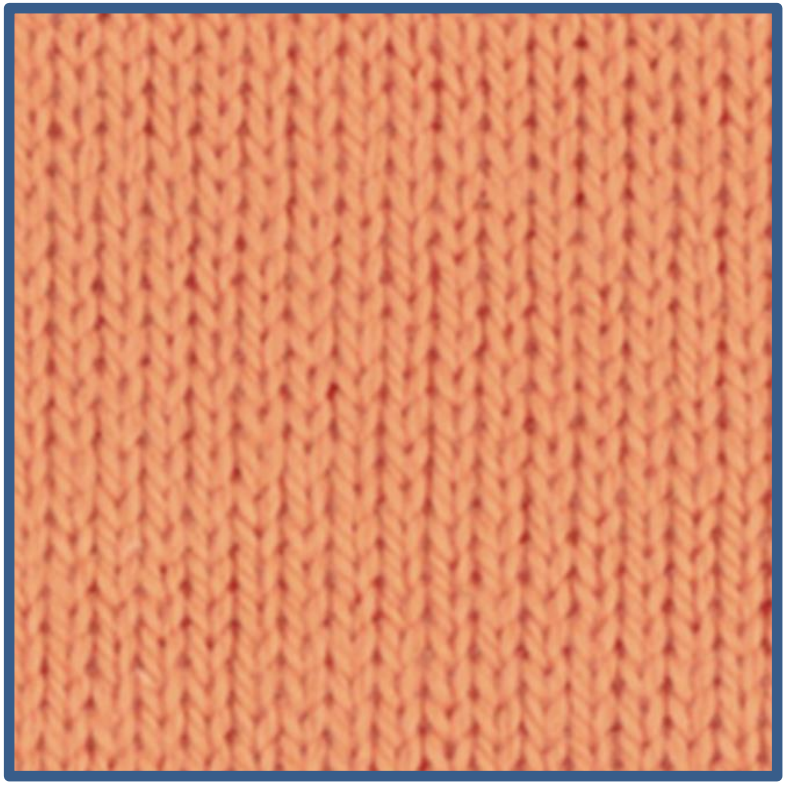
- For a given product, specifications are set for many areas of performance. In this discussion, objective performance criteria of yield, width, and shrinkage are highlighted because they are inter-dependent.
- Of course, product costs are paramount.

Fabric Yield

- The yarn size, the stitch density (knits) or thread counts (wovens), and processing parameters determine the fabric yield or weight.
- At any point in processing the yield is expressed as ‘delivered’ to the next process and can change from process to process.
- Yield is most often expressed as:
  - Oz/yd^2, gms/m^2
  - Oz/yd at __ inches width, gms/m @ ___ cm width.
  - Yds/Lb, Meters/Kg.

Single Jersey – 7-Cut – 8/2 Ne

Reference State



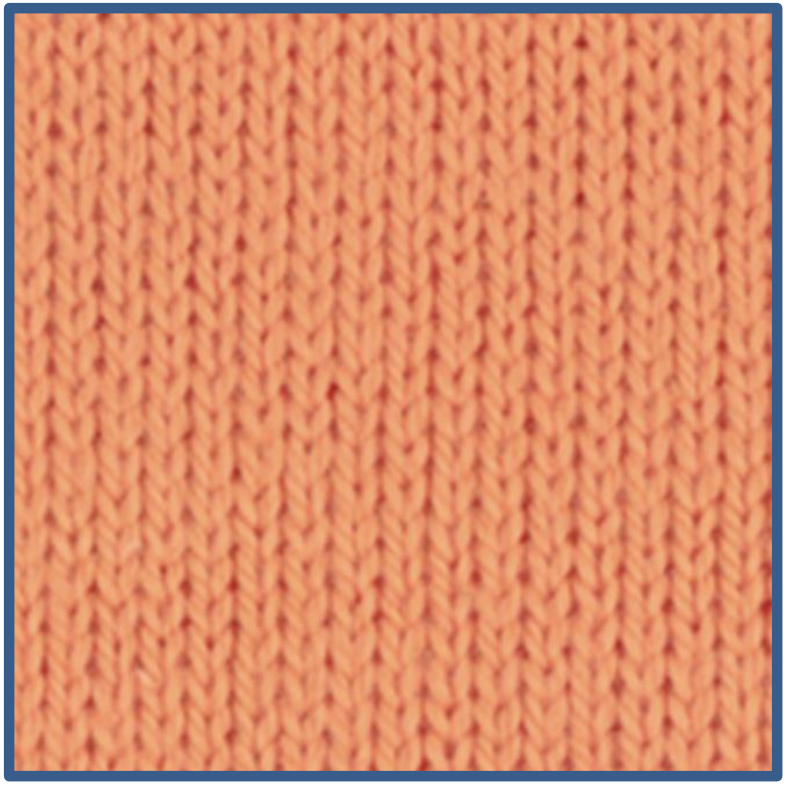
10.0 Oz/Yd^2 (339 gm^2)

20 x 16

Course/Wales Per Inch

Single Jersey – 7-Cut – 8/2 Ne

Reference State

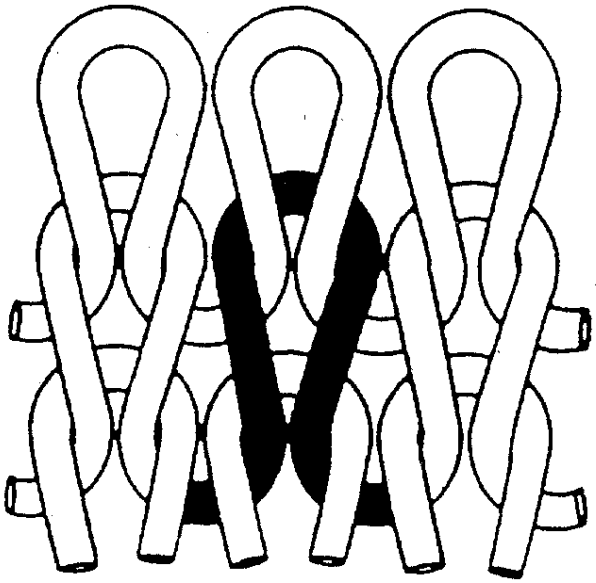


10.0 Oz/Yd^2 (339 gm^2)
20 x 16
Course/Wales Per Inch

Delivered State
Shrinkage 10% x 10%

8.1 Oz/Yd^2 (275 gm^2)
18 x 14.5
Course/Wales Per Inch

Impact of Stitch Length



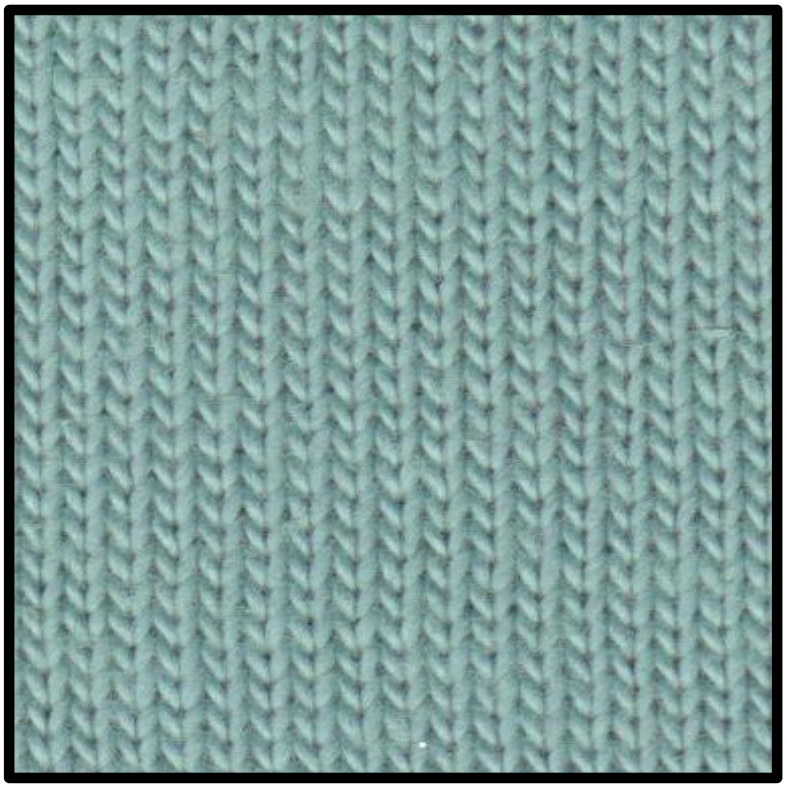
JERSEY STITCH

- The amount of yarn in one stitch repeat.
- Easiest parameter to change on the knitting machine.
- Controls the weight, production rate, shrinkage, and other important aspects of the fabric.

Single Jersey – 10-Cut – 5/1 Ne

Reference State

Stitch Length = Tight



13.1 Oz/Yd^2 (444 gm^2)

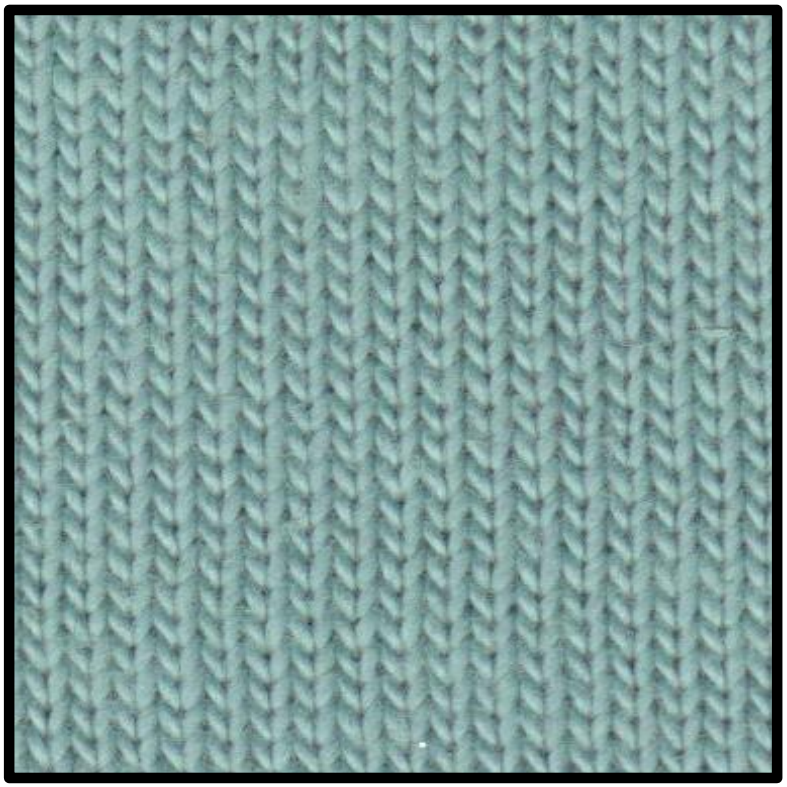
24 x 17

Course/Wales Per Inch

Single Jersey – 10-Cut – 5/1 Ne

Reference State

Stitch Length = Tight

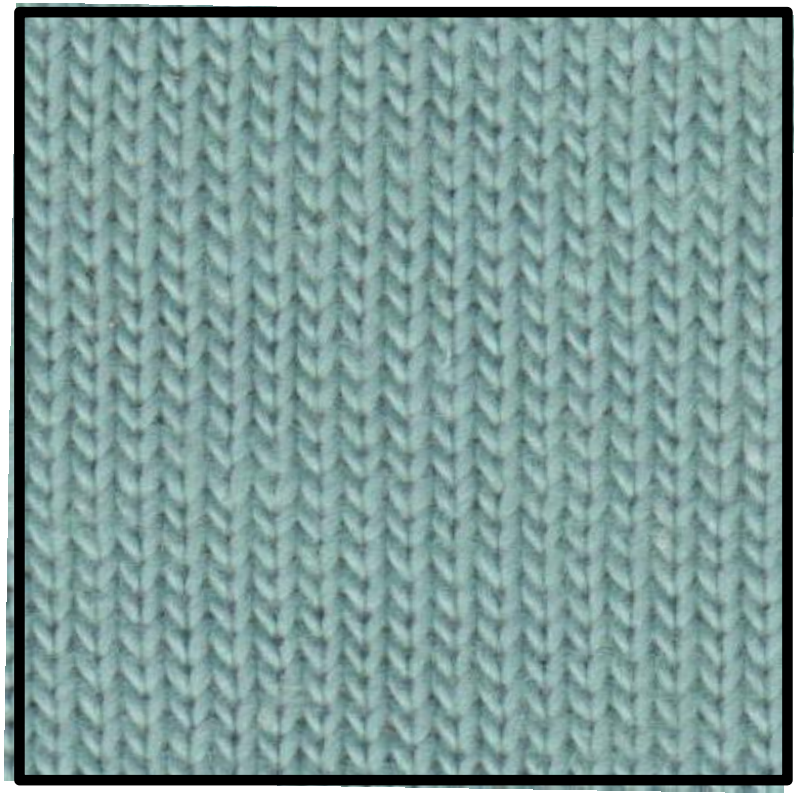


13.1 Oz/Yd^2 (444 gm^2)

24 x 17

Course/Wales Per Inch

Stitch Length = 4% Loose



12.5 Oz/Yd^2 (424 gm^2)

23 x 17

Course/Wales Per Inch

What is the significance of making a looser stitch on production rate and costs?

In the previous example, knitting looser by one course per inch results in the following:

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- Meaning a ‘bonus’ of 41.7 yards for every 1000 yards made. More yards to cut & sew mean more profits.
- However, the looser fabric will shrink more.

Effect of Changing Stitch Length

Conclusions

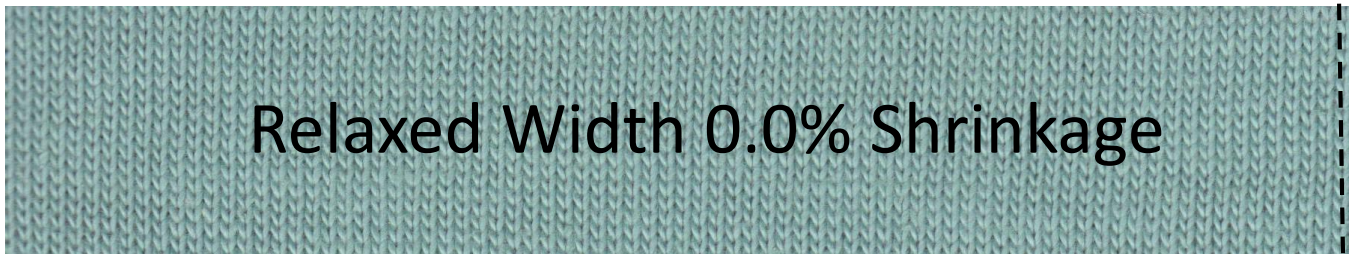
The shorter the stitch length:

- the tighter the stitch
- the less the length shrinkage
- the more the width shrinkage
- the narrower the fabric
- the heavier the fabric
- less torque or skew
- the less yards of fabric per pound of yarn

The tightest stitch length is not necessarily best:

- harder to knit
- harder to dye
- cost more to make

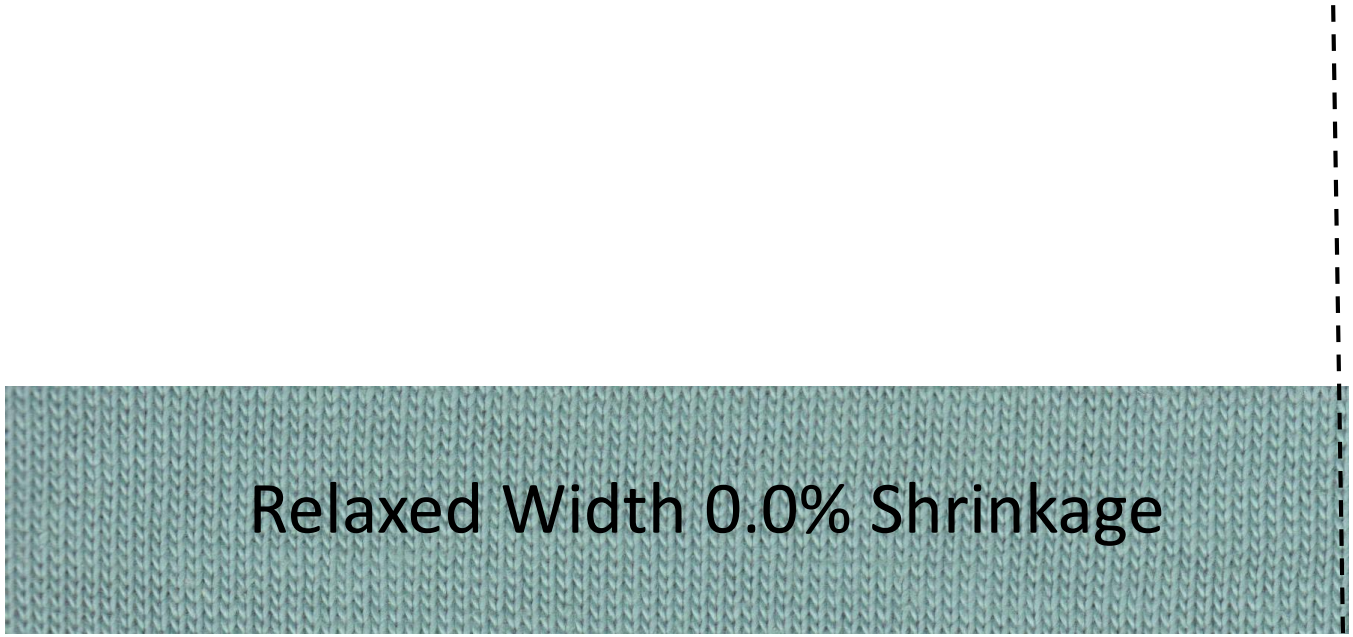
Effect of Changing Cut-and-Sew Width



60” Width Overall

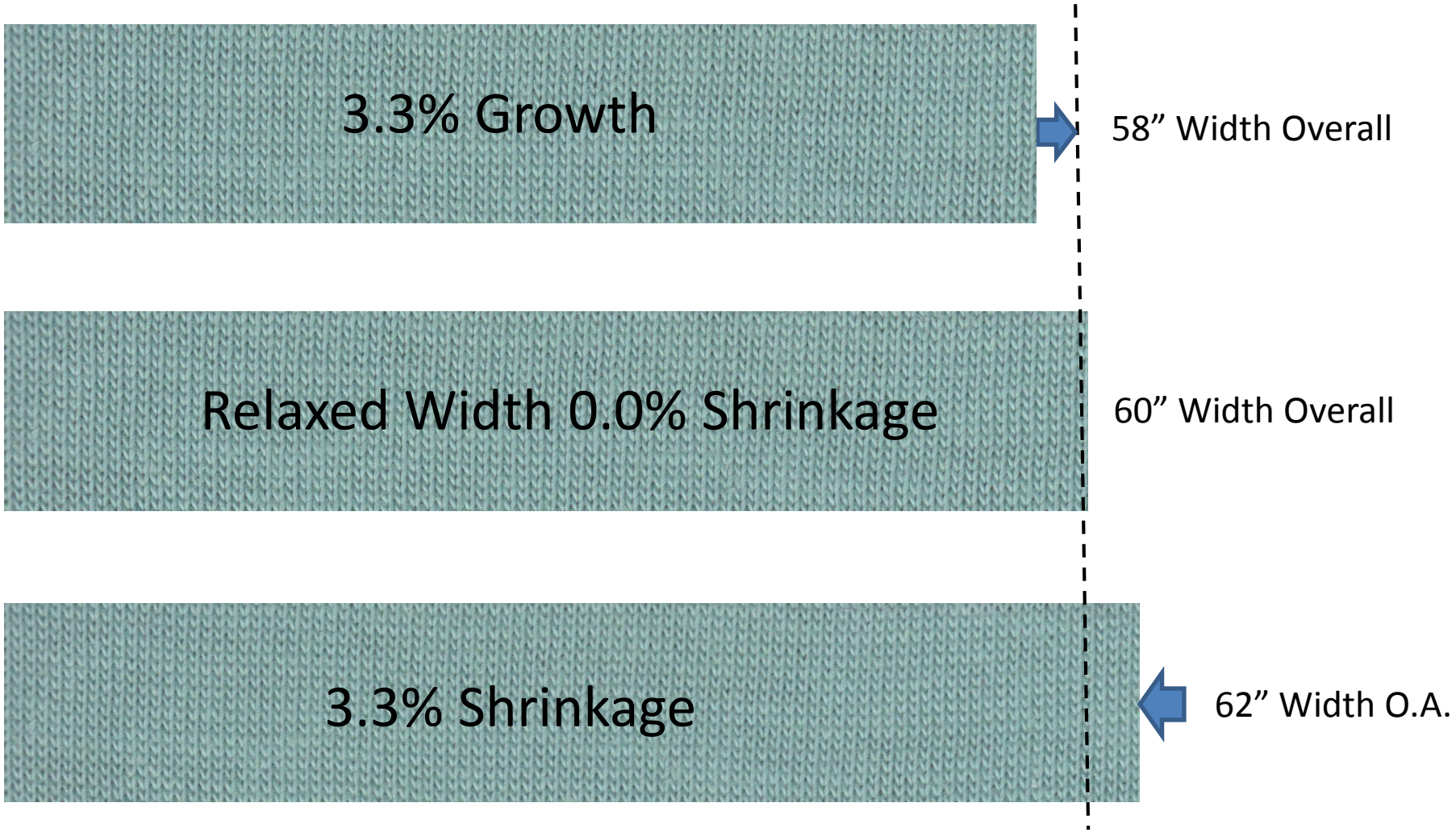
Same Fabric With Only Finished Width Changed

Effect of Changing Cut-and-Sew Width



Same Fabric With Only Finished Width Changed

Effect of Changing Cut-and-Sew Width



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- If the fabrics are dried (de-swelling) in this crimped condition under no tension and with significant mechanical action, then they will shrink.
- After drying, further stabilization of shrinkage can be gained with compaction or by the addition of cross-linking chemistry.

What are the Factors in Drying That Shrink Fabrics?

- The tumble dryer whether in a mill, the consumer's home, or in a laundry is the optimum shrinking machine. However, it is not a practical means to dry fabrics in a mill.

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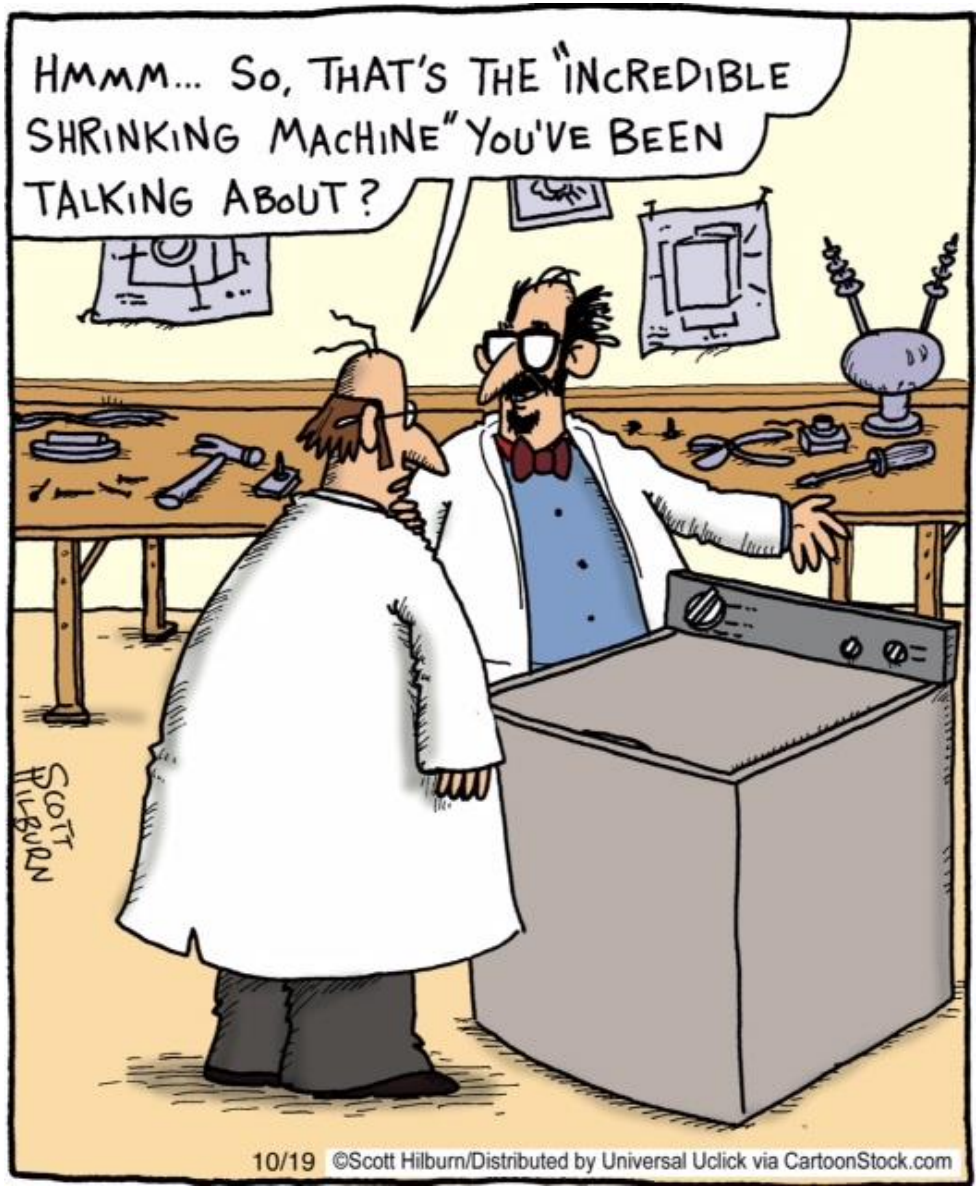
- The tumble drier whether in a mill, the consumer's home, or in a laundry is the optimum shrinking machine. However, it is not a practical means to dry fabrics in a mill.
- This stress free drying system uses large amounts of mechanical action to shrink fabrics as they dry.
  - The truth is ….. ***HEAT DOES NOT SHRINK COTTON FABRICS***…! Excess heat may cause yellowing, a stiffer hand, or slower re-wetting, but not shrinkage.
  - Some synthetic fibers such as spandex are sensitive to heat and will shrink.

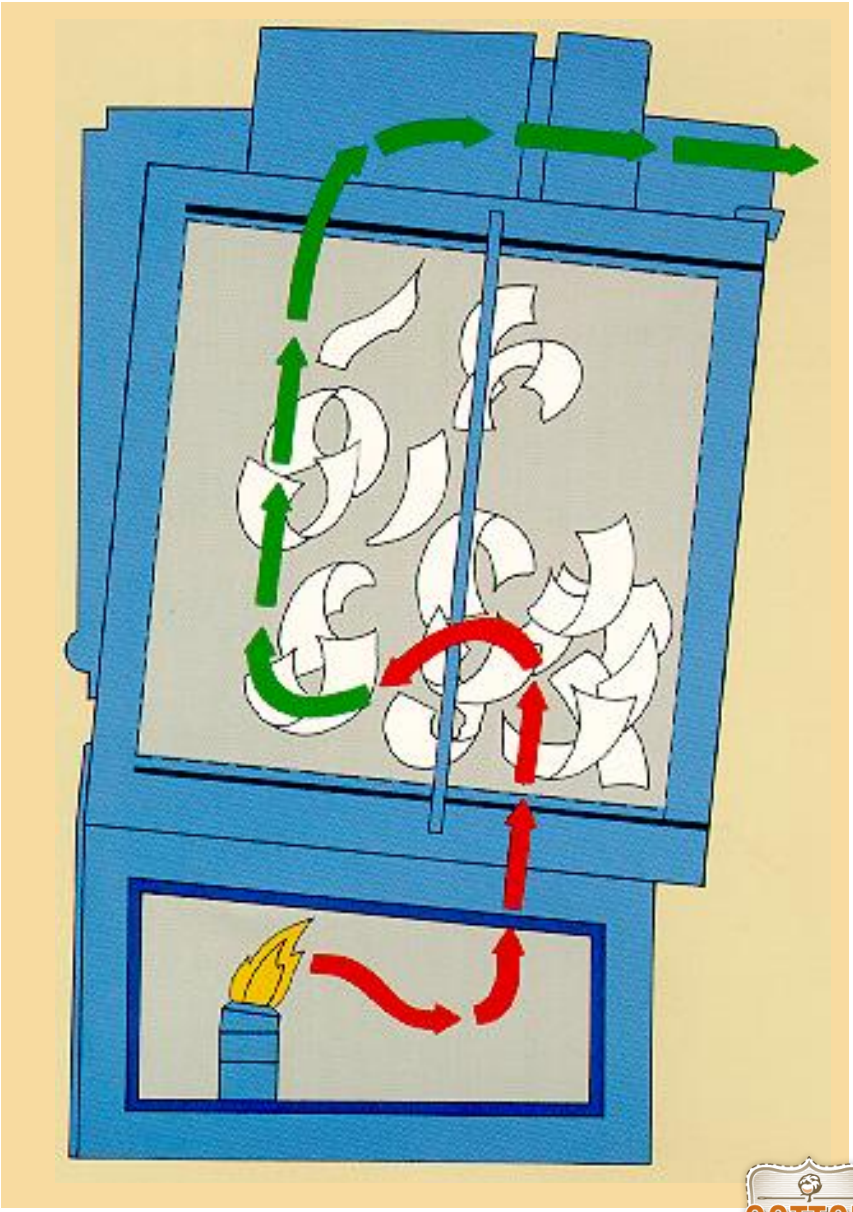
TUMBLE DRYER



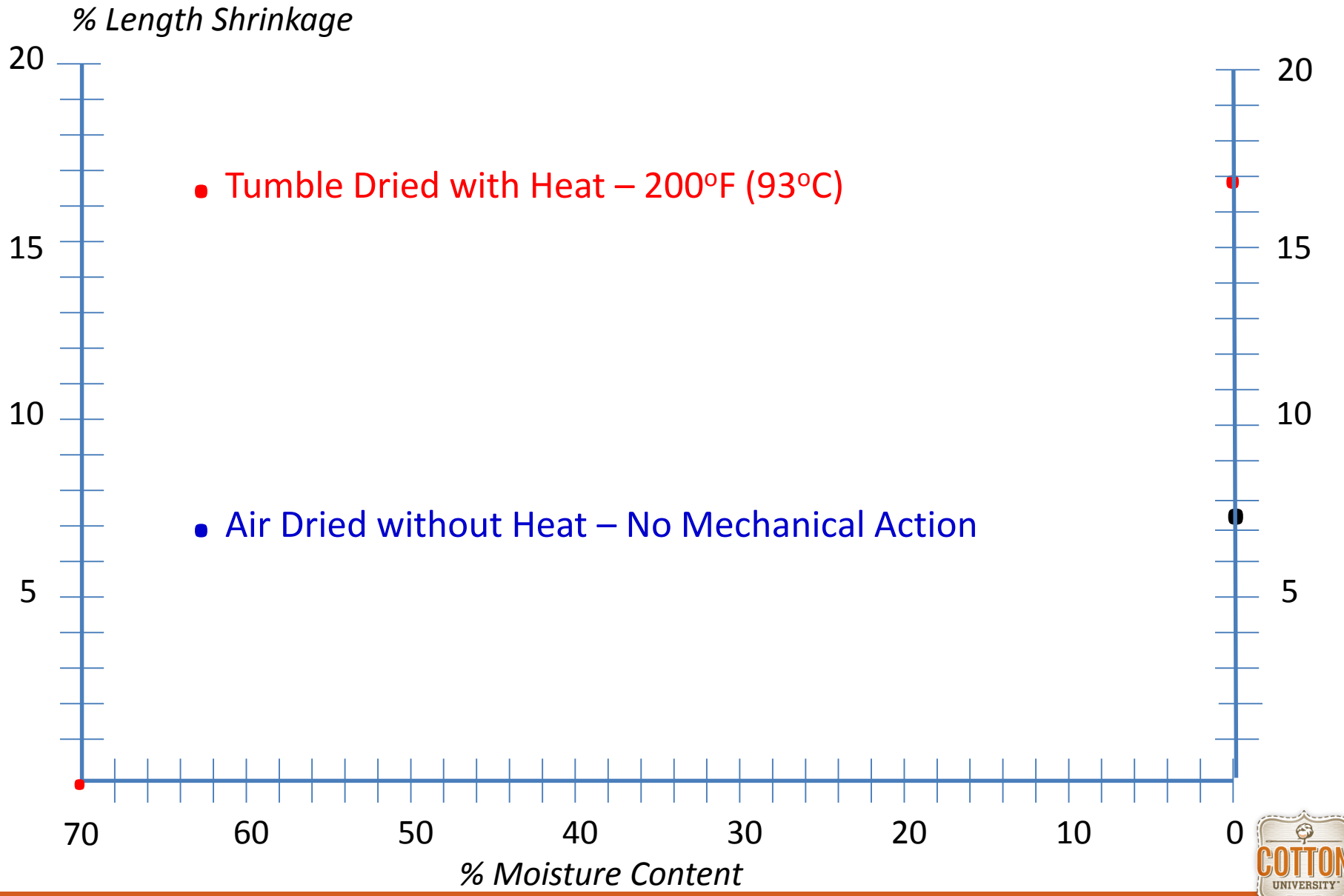
Tumble Dryer

Applies extreme levels of stress-free mechanical action.

The result is a consolidation of the fabric.



Influence of Heat and Moisture Content on The Shrinkage with Tumble Drying



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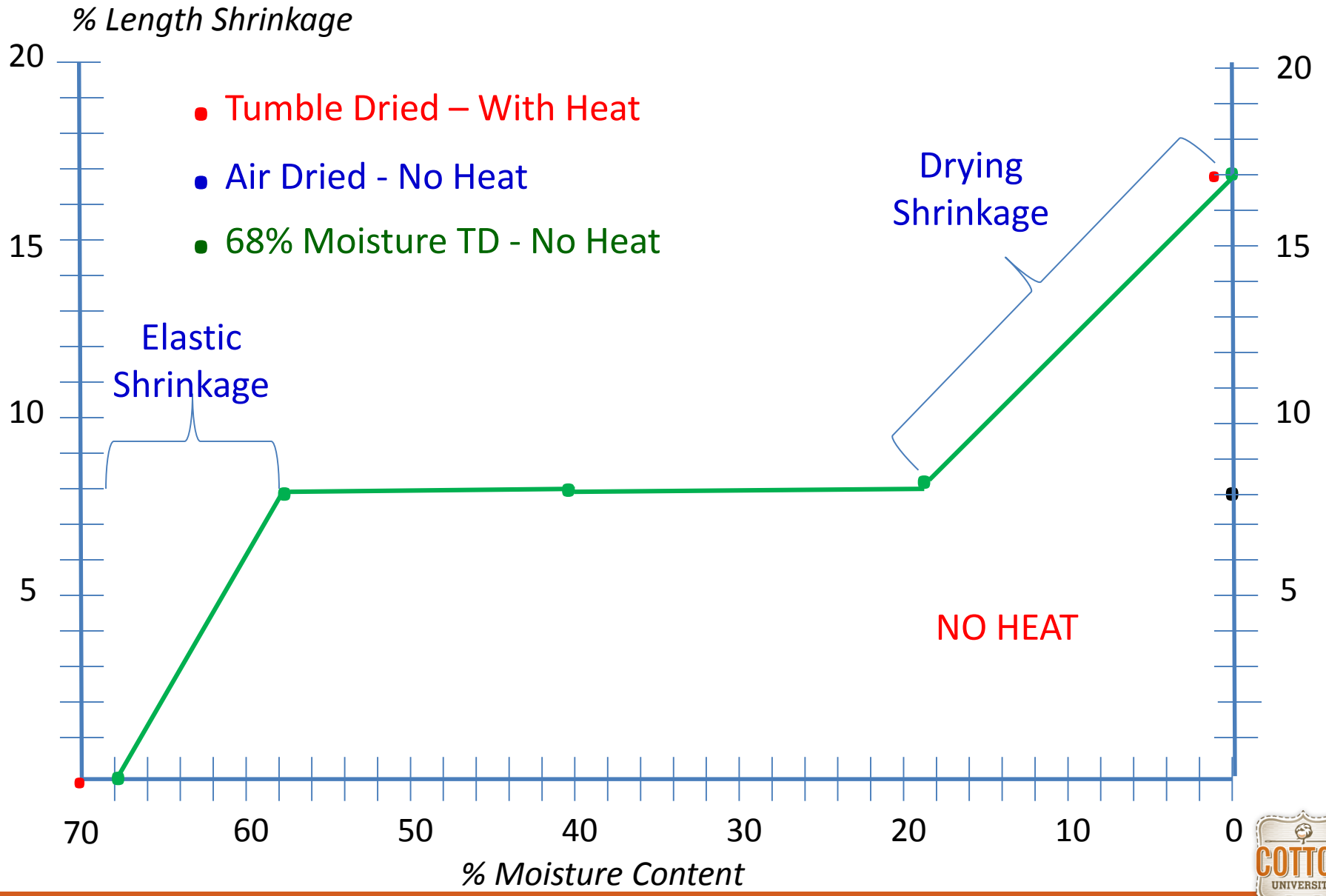

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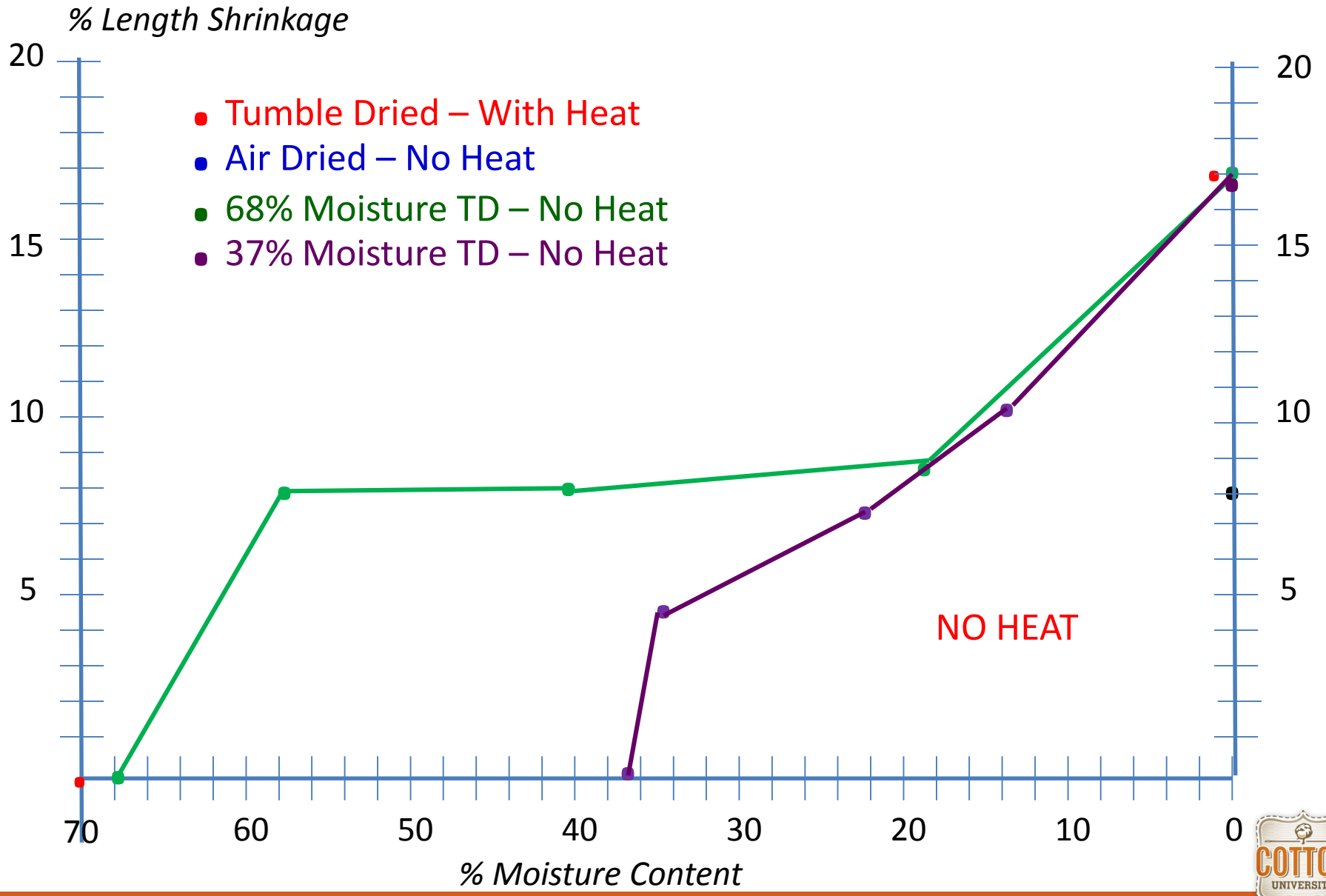
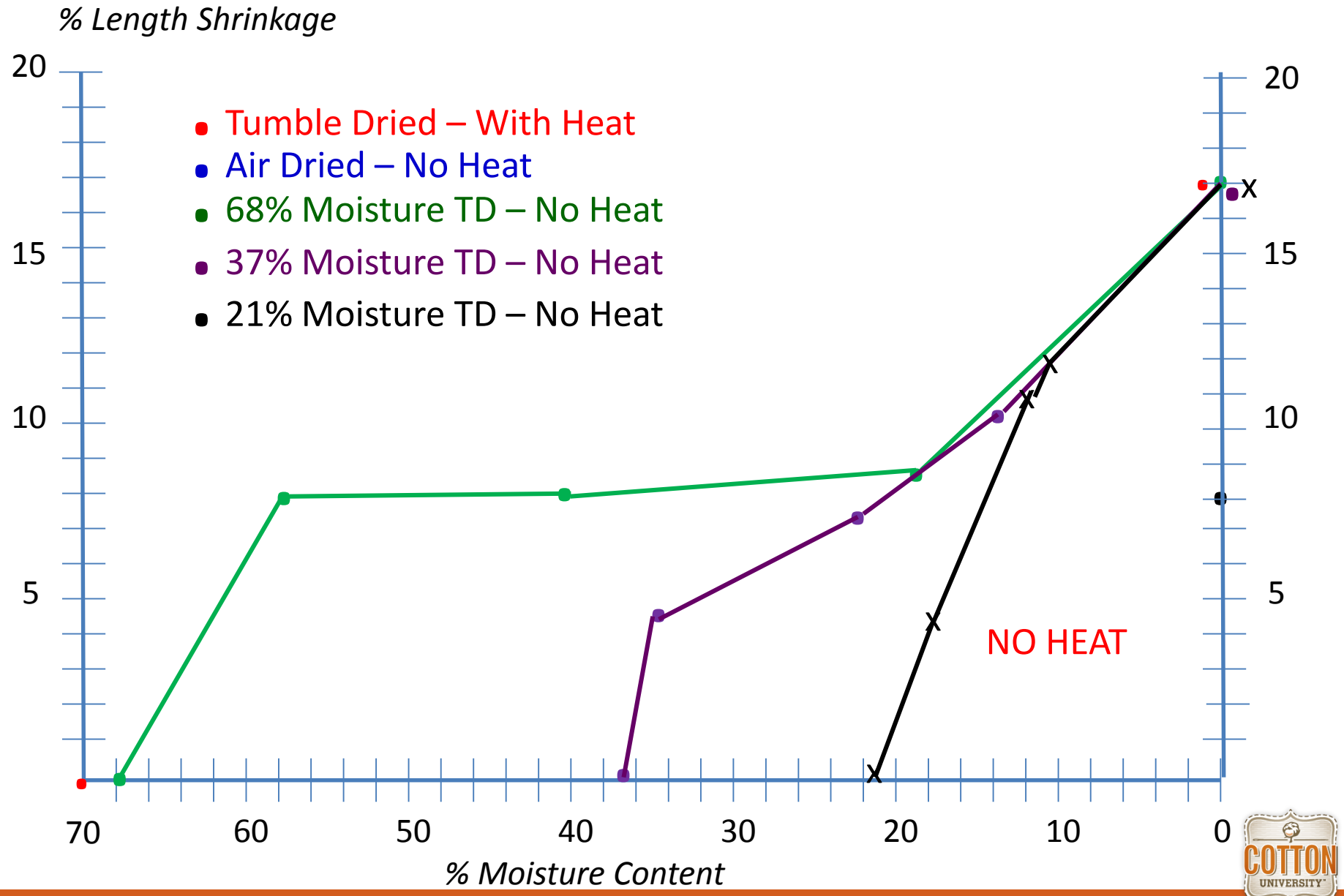


Influence of Heat and Moisture Content on The Shrinkage with Tumble Drying



Summary of Shrinkage Discussion

- Shrinkage occurs when tested by mills, brands, and retailers. More importantly it is measured by the consumer, the ultimate testing lab.
- Careful development of the fabric must include the specifications of weight, cut-and-sew width, and allowable shrinkage.
- Construction, dyeing, and finishing parameters can cause variance in the weight and width resulting in loss of shrinkage control.
- Drying under the lowest tensions and maximum mechanical action will reduce shrinkage.
- Compaction and resin finishing can also reduce shrinkage.

Question and Answer

Please submit any final questions now.

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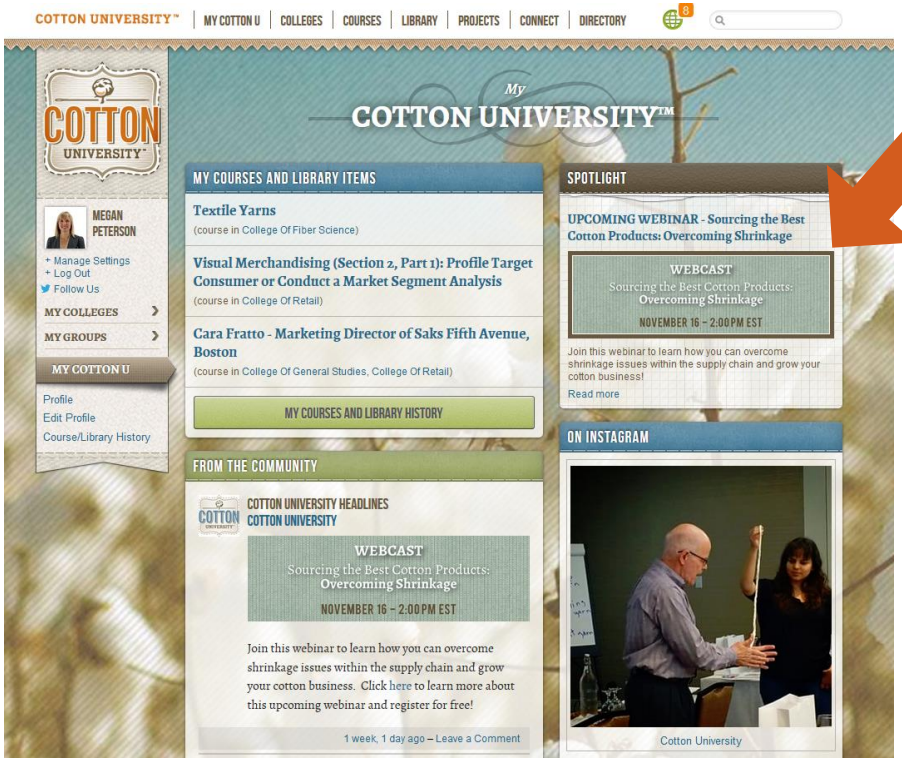

Look for the Webcast Course in the Spotlight or the College of Quality Assurance

ADDITIONAL WEBCAST RESOURCES

- Webcast slides for download
- Additional Q&A
- "Guide to Improved Shrinkage Performance of Cotton Fabrics"
- "Wet Processing of 100% cotton Knitted Fabric"

Check out
"The Art of Shrinkage Control"
in the
College of Quality Assurance

QUALITY ASSURANCE No. 1 QA QUALITY ASSURANCE

1. Shrinkage Basics
2. Knit Fabric Shrinkage
3. Shrinkage Testing