TECHNICAL BULLETIN

COTTON INCORPORATED

6399 Weston Parkway, Cary, North Carolina, 27513 • Telephone (919) 678-2220

TRI 3008

PROCESSING 100% COTTON

WOVEN FABRICS

FOR FILLING STRETCH

TABLE OF CONTENTS

OVERVIEW

Natural Stretch is a method of enabling mechanical stretch in woven 100% cotton fabrics through slack mercerization, eliminating the use of polymer-based elastane yarns. This is accomplished by weaving the fabric wide, then allowing the width of the fabric to come in during slack mercerization. The crimp of the filling yarns is increased through mercerization, creating a spring-like effect that allows the fabric to stretch about 15%, while still maintaining good recovery. The equipment needed for this process is common to cotton manufacturing.

Natural Stretch technology offers an alternative to polymer-based stretch wovens. While it does not achieve the power stretch characteristics of elastane, it does provide comfort stretch with 10–15% stretch and sometimes approaches 20% stretch. The stretch is permanently built into the textile with subsequent washings restoring stretch to initial levels. Natural Stretch fabrics remain 100% cotton, so from an environmental perspective, at the end of the garment's lifecycle it is a single material that is either biodegradable or recyclable.

Several factors of weave construction affect the amount of stretch that is achievable in fabrics. More weft interlacements and more crimp equal more stretch. In general, plain weaves have more stretch than twills or satins. Lighter weight fabrics such as shirting fabrics have more stretch potential than heavy weight fabrics such as bottom weights. Higher ends per inch have more potential for stretch than lower ends per inch.

Higher crimp is achieved by reeding out the fabric at the loom, so the griege fabric is about 25% wider than the finished fabric. Then the fabric shrinks in finishing, where the crimp is exaggerated and locked in. Another way of saying this is that the fabric is woven wider and at a lower ends per inch than the finished fabric and the fabric shrinks to its intended width and ends per inch in finishing. The finished fabric has permanent properties that allow it to stretch and recover, mechanically.

HISTORICAL BACKGROUND

John Mercer invented Mercerization in 1844.[1] Mercerization is a chemical process where cotton is treated with about a 20% solution of sodium hydroxide, which changes cellulose I (natural cellulose) to cellulose II. In 1889 Horace Lowe developed a process to mercerize yarn under tension to minimize shrinkage, which imparted a luster to the yarn. This luster from mercerization is what most people understand mercerization to impart.

Mercerizing leads to several changes in fiber and fabric properties:

- A more circular fiber cross-section

---

[1] Clibbens, D. A. (1923). The Mercerization of Cotton - A Review of the Literature. *Journal of the Textile Institute*, 217-249.

- Increased luster
- Increased tensile strength, a major factor for technical textile fabrics
- Increased apparent color depth after dyeing
- Improved dyeability of immature cotton (greater uniformity of appearance)
- Increased fiber moisture regain
- Increased water sorption
- Improved dimensional stability.

Shrinkage was always deemed a challenge to overcome in mercerization until 1943 when Charles Goldthwait, a USDA researcher, invented a "Method of Producing Surgical Bandages with Improved Elastic Properties." (USPTO 2,379,574[2]) Goldthwait describes a process of weaving a gauzy cotton woven and letting it shrink freely to create a wound dressing with 4-way natural stretch. Following the stretch gauze, Goldthwait devised a "Method of Making Cotton Fabrics with Differential Elastic Properties" (USPTO 2,404,837[3]) where he describes a way to impart stretch across the width of a woven fabric through controlled mercerization while maintaining tension on the warp.

Goldthwait continued to research the properties of mercerized cotton, but little work on stretch was done until the 1960's when researchers explored slack mercerization on commercial mercerization ranges. Normally, finishers maintain tension in the filling direction to minimize shrinkage so they can deliver more square yards of fabric. In the natural stretch mercerization process, the woven fabric is held under tension in the warp direction, while being allowed to come in in the width in the filling direction. This shrinkage allows the filling yarn to crimp over the profile of the warp yarns, creating a weft yarn profile that can extend and retract.

---

[2] Goldthwait, C. F. (1943, November 5). *United States of America Patent No. 2379574.* Retrieved from https://patents.google.com/patent/US2379574A

[3] Goldthwait, C. F. (1943, November 5). *United States of America Patent No. 2404837.* Retrieved from https://patents.google.com/patent/US2404837A

MECHANICAL STRETCH

Stretch from Mercerization is enabled through locking in the crimp of the yarn and fibers in finishing[i]. Many woven fabrics have some degree of stretch (about 5%) built into the structure due to the sine wave of the filling yarn over and under the warp yarns. The stretch occurs from the sine wave of the weft yarn flattening out when stretched, thereby extending the width of the textile. When the yarn is released, it relaxes back into the sinewave shape, giving the fabric recovery.

Natural Stretch technology amplifies that sine wave. The woven fabric is woven about 25% wider with the same number of ends to give the fabric more space to shrink to the normal

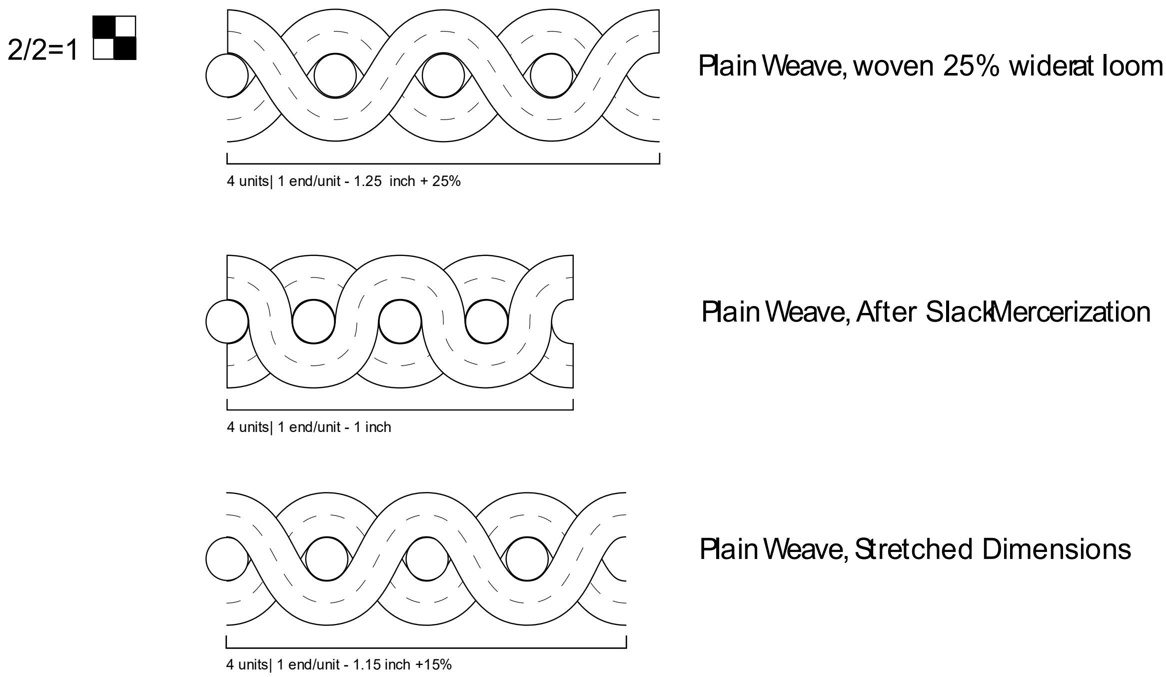


Figure 1Plain Weave in weaving, after finishing, and in a stretched state.

finished width. During the finishing process, when the fabric is relaxing to its final width, the sine wave of that yarn is locked by mercerization, essentially turning it into a shape memory yarn.

EQUIPMENT CONSIDERATIONS

Standard weaving and finishing equipment for mercerized cotton wovens will work for this process, but some things must be considered. The machine widths available is the first thing to consider. In ideal conditions a fabric could be designed significantly reeded-out in weaving and would be allowed to come into its finished dimensions during finishing. In reality, there are limits in machinery capabilities within every mill.

For example, a common width for a 'wide' loom is 180cm. (73.5 inches) The wide width of a mercerization range is often 180cm, with a lower limit of 140cm (57 inches) on the chain. With these conditions, the widest one could reed-out the fabric would be about 28.5%. Widths of other finishing equipment such as Stenter Frames will also need to be accounted for, where the range of width capabilities affect greige and finished fabric widths.

WEAVING SETUP

Weaving parameters are the foundation of the final product considerations. The goal is to finish the goods to as high a crimp and cover factor as the fabric will allow. Another way to say this is that the fabrics should have an ideally packed warp density when finished. The weave settings will be adjusted to be 25% wider than finished, but with the same total number of ends reeded out to the wide greige width. There are multiple ways to arrive at the ideal density, such as Pierce's[4] formulas or Ashenhurst's[5] formulas. One could also look for existing non-stretch fabrics as a basis. In general, it is best to use the finished dimensions of a non-stretch woven as the starting point.

For example, a 4.8 oz plain woven using 20/1 Ne Cotton at 74 ends per inch by 54 picks per inch and is 59 inches wide. The greige fabric is 60 inches (150mm) wide at the reed, so 4320 ends at 72 ends per inch, equaling 2 ends per dent on a 36 dent per inch reed. One must adjust for shrinkage during slack mercerization. Through experimentation, it has been found that a 25% increase in width is ideal for this part of the process in almost all wovens. We calculate 60 + 25% = 75 inches, so we must reed out the ends to 75 inches (190mm). 4320/75 = 57.6 ends per inch, which is not a typical reed size. We round up to a more common reed size to get 60 ends per inch, or 2 end per dent in a 30 dent reed. To compensate for this change, we could either make our reed width 72.8 inches or increase the number of ends to 4500. In this project we opted to weave at 72.8 inches. After slack mercerization, the width of the finished goods is 59 inches with 16% stretch.

In another example, a 7.4oz 3/1 twill woven using 16/1 Ne Cotton at 84 ends per inch by 64 picks per inch and is 56 inches wide. The greige fabric is 60 inches (150mm) wide at the reed, so 4800 ends at 80 ends per inch, equaling 2 ends per dent on a 40 dent per inch reed. We calculate 60 + 25% = 75 inches, so we must reed out the ends to 75 inches (190mm). 4800/75 = 64 ends

[4] Peirce, F. T. (1947, March). Geometrical Principles Applicable to the Design of Functional Fabrics. *Textile Research Journal*, 123-147. Retrieved from https://journals.sagepub.com/doi/abs/10.1177/004051754701700301

[5] Ashenhurst, Thos (1892). A Treatise on Textile Calculations and the Structure of Fabrics, Huddersfield, J. Broadbend and Co., Albion Printing works, High Street. Retrieved from https://www2.cs.arizona.edu/patterns/weaving/books/atr_calc.pdf

per inch, equaling 2 ends per dent on a 32 dent per inch reed. After slack mercerization, the width of the finished goods is 56 inches with 10% stretch.

EFFECT OF WEAVE STRUCTURE AND WEIGHT

The number of crossings in the weave structure changes the amount of stretch possible in the finished goods. Plainweave has the most interlacement across the width of the fabric, so it is possible to achieve 15%–18% stretch. Twills and Satins have less interlacement, and can be woven at higher end counts, but still can't achieve the same number of interlacements per inch as plainweave. This means Twills and Satins are more limited in stretch, with 10%-15% being a more realistic expectation.

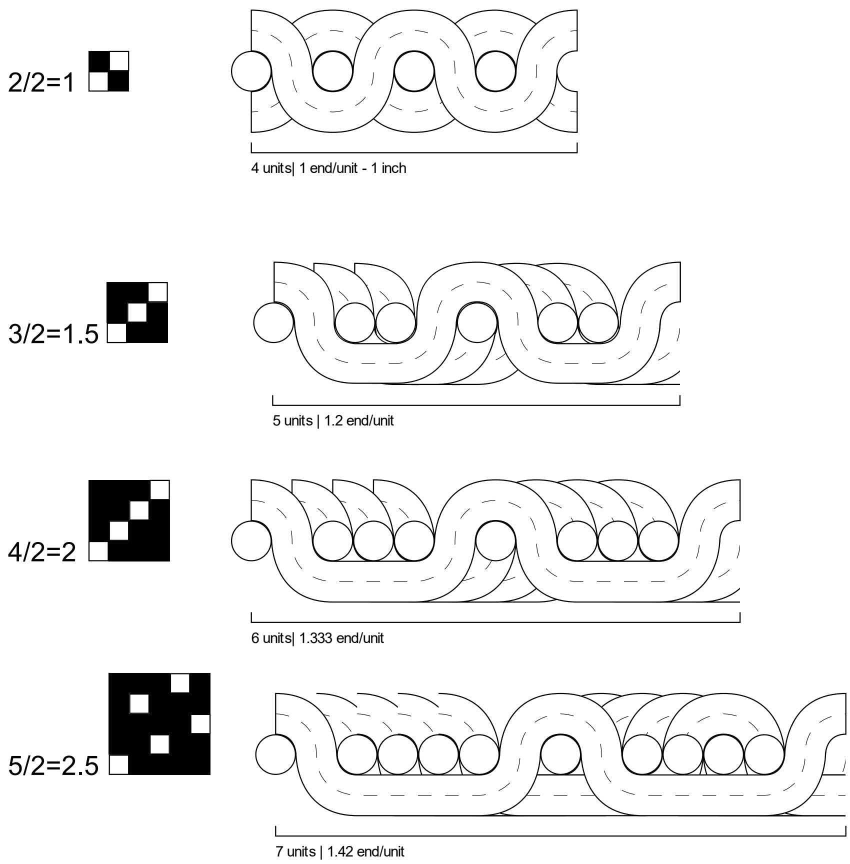


Figure 2 Illustration of potential number of crossings in different weave designs.

Fabric weight can also affect the amount of stretch in the fabric, but not as significantly as weave structure. In general, lighter weight fabrics could have more stretch than heavier weight fabrics. This is likely because lighter weight fabrics can have higher end counts than heavier weight fabrics, therefore more interlacements per inch. In practice, we've been able to achieve good stretch across the weight range of given weaves.

Table 1 Weight versus stretch (ASTM D3107) see Appendix A

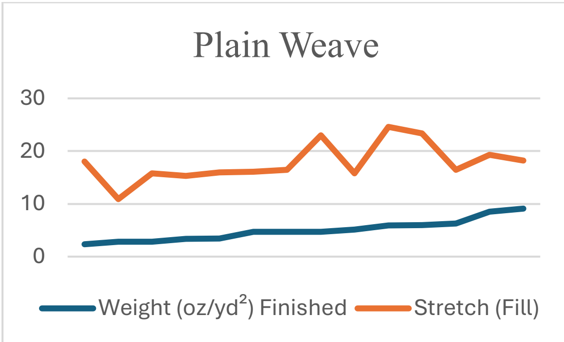
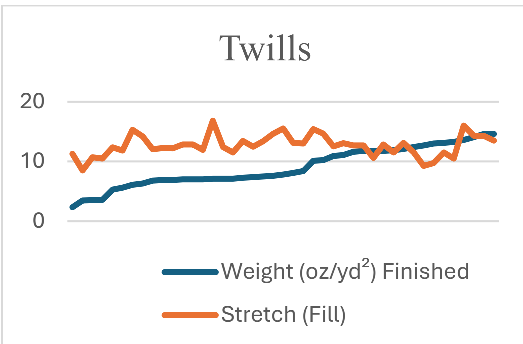


Table 2 Weight versus stretch (ASTM D3107) see Appendix B



PREPARATION

A singe, desize, scour, and bleach by normal methods are usually satisfactory.

MERCERIZATION

Although this is one of the more critical steps in producing a satisfactory fabric for filling stretch, it should not be any more difficult than conventional mercerization.

Preliminary laboratory work is important, and two plant methods have been satisfactorily evaluated. Details follow.

Laboratory Procedure - Prior to processing fabric in the plant, a piece of full-width greige fabric should be laboratory desized and slack mercerized in 48° to 50° Twaddle (Tw) sodium hydroxide (24 or 25% at 30° C). The width after washing and drying determines the starting width on a chain mercerizer. (See Appendix C)

Chain Mercerize (Plant) - Slack mercerize on chain mercerizer with 48° to 50° Twaddle (Tw) sodium hydroxide. Starting width can be determined by the laboratory sample. After starting, the chain width should be adjusted to hold the fabric in the chain without creasing. Cascades and vacuums should be turned off so as not to cause extra weight and pull fabric out of the chain. The purpose of caustic treatment here is to make the fabric shrink in the width; therefore, removal of the sodium hydroxide down to a level of 5% before leaving the chain is not as critical as in conventional mercerization. Once the fabric exits the chain, good rinsing followed by acid neutralization should be performed as shown in the example below for the Benninger Dimensa Mercerizer.

BENNINGER DIMENSA Mercerizer Diagram

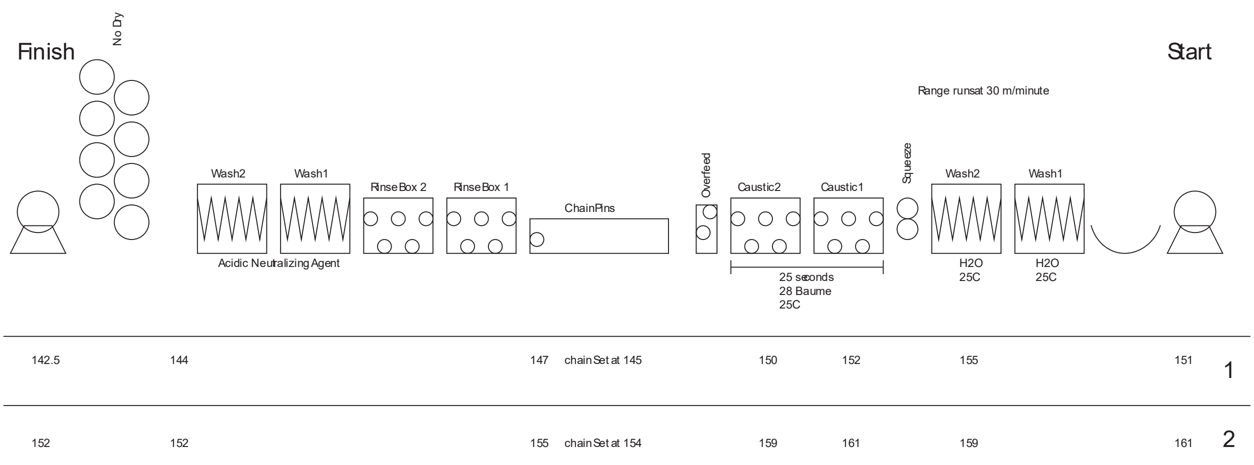


Figure 3 Example of Benninger Mercerizer with width readings (in cm) throughout process.

<u>Mercerize (Roll Accumulator)</u> - Fabric can be caustic slack mercerized with 48° to 50° Tw sodium hydroxide using other equipment. The range used in one example consisted of: two caustic saturators; a roll accumulator with 2 minute dwell at 60 yds/min; 11 wash boxes; wash box 1–7 hot water wash; wash box 8, acid; 9, 10, and 11, hot water wash, dried on cans.

DYEING

Dye fabric by normal methods. Fabric to be resin finished after dyeing should have a total alkalinity of less than 0.05% (expressed as NaOH) to ensure fixation.

FINISHING

Final stretch and recovery and shrinkage control are determined by this important process. Again, preliminary laboratory work is important to determine the proper finished width as shown in Appendix C.

Durable press finishes may be used on Natural Stretch fabrics, as woven cotton fabrics may need to be treated for maintaining smooth appearance and shrinkage control in home laundering. Lighter weight fabrics tend to develop higher stretch and growth than bottom weight fabrics, so if growth is of concern, durable press finishing may be performed to reduce growth. On the other hand, too much durable press resin can reduce stretch, so the amount of resin should be predetermined in the laboratory or in pilot-scale trials prior to production processing.

Appendix A Plain Weave Data

PROJECT ID	WEAVE	WIDTH (IN.) GREIGE	WIDTH (IN.) FINISHED	WEIGHT (OZ/YD²) GREIGE	WEIGHT (OZ/YD²) FINISHED	STRETCH (FILL)	GROWTH (FILL)	THREAD COUNT (WARP) GREIGE	THREAD COUNT (WARP) FINISHED	THREAD COUNT (WEFT) GREIGE	THREAD COUNT (WEFT) FINISHED	DENTS PER INCH	ENDS/DENT	REED WIDTH (IN.)	YARN SIZE (WARP)	YARN SIZE (WEFT)
70701N65	Poplin	68.90	56.30	2.02	2.34	18.00	8.50	76.20	100.92	82.00	82.04	38.10	2.00	74.37	60/1 Pima	60/1 Pima
70701N01	Poplin	70.08	59.06	2.50	2.83	10.90	7.10	116.84	145.93	112.00	114.96	58.42	2.00	73.54	70/1 +140/2 Pima	70/1 +140/2 Pima
70701N91	Poplin	70.08	59.06	2.50	2.84	15.80	6.50	116.84	145.93	112.00	115.06	58.42	2.00	73.74	70/1 Pima	70/1 Pima
70701712	Poplin	71.26	59.06	2.91	3.34	15.30	7.00	101.60	128.99	90.00	91.44	50.80	2.00	74.17	50/1 Pima	50/1 PA2.KP.
50501N01	Poplin	70.47	59.06	3.00	3.42	16.00	6.60	76.20	96.81	80.00	81.79	38.10	2.00	74.80	40/1 Upland	40/1 Upland
6398 B	Plain	56.00	49.30	4.80	4.70	16.07	3.37	64.30	73.70	57.70	53.70	30.00	2.00	60.00	20/1 Ne	20/1 Ne
6398 A	Plain	56.00	49.60	4.80	4.70	16.47	3.80	64.30	72.70	57.70	54.70	30.00	2.00	71.00	20/1 Ne	20/1 Ne
6037	Plain	65.50	52.30	4.40	4.70	23.00	7.03	64.30	82.30	57.00	52.70	30.00	2.00	71.00	25/1,22/1	25/1,22/2
6036	Plain	67.10	55.70	5.00	5.10	15.77	2.13	70.00	76.30	51.00	50.00	30.00	2.00	71.00	18/1,15/1	18/1,15/2
6140-1	Plain	67.90	52.30	5.20	5.90	24.60	8.30	56.00	72.00	47.00	44.70	26.50	2.00	71.00	30/2 Ne	30/2 Ne
6140	Plain	67.90	51.00	5.20	6.00	23.37	5.73	56.00	74.30	47.00	44.30	26.50	2.00	71.00	30/2 Ne	30/2 Ne
6038	Plain	67.30	56.90	6.70	6.30	16.43	2.97	63.70	81.70	56.30	47.00	30.00	2.00	71.00	20/1 Ne	20/1 Ne
6136	Plain	66.50	52.50	7.60	8.50	19.33	3.73	33.70	42.00	38.70	35.30	15.50	2.00	71.00	14/2 Ne	14/2 Ne
6135	Plain	57.10	47.30	8.80	9.10	18.23	3.47	42.30	50.70	39.00	35.00	20.00	2.00	60.00	14/2 Ne	14/2 Ne

Appendix B Twill Weave Data

PROJECT	WEAVE	WIDTH (IN.) GREIGE	WIDTH (IN.) FINISHED	WEIGHT (OZ/YD²) GREIGE	WEIGHT (OZ/YD²) FINISHED	STRETCH (FILL)	GROWTH (FILL)	THREAD COUNT (WARP) GREIGE	THREAD COUNT (WARP) FINISHED	THREAD COUNT (WEFT) GREIGE	THREAD COUNT (WEFT) FINISHED	DENTS PER INCH	ENDS PER DENT	REED WIDTH (IN.)	YARN SIZE (WARP)	YARN SIZE (WEFT)
70704N49	2/2 RHT	66.14	58.27	2.34	2.34	11.30	5.10	152.40	183.84	120.00	127.00	50.80	3.00	70.12	90/1 Pima	90/1 Pima
70703N03	3/1 RHT	64.96	57.48	3.28	3.49	8.50	5.40	142.24	172.03	116.00	120.14	35.56	4.00	69.41	60/1 Pima	60/1 PA2.KP.
70703N01	3/1 RHT	66.34	59.06	3.29	3.52	10.70	4.00	152.40	179.31	102.00	107.98	38.10	4.00	69.37	60/1 +120/2 Pima	60/1 Pima
41413N01	3/1 RHT	64.96	57.48	3.36	3.59	10.50	4.30	142.24	172.03	120.00	120.14	35.56	4.00	69.41	60/1 Organic Pima	60/1 Organic Pima
6399 A-1	2/1 RHT	56.90	51.30	5.70	5.30	12.37	3.63	73.00	80.70	64.70	62.00	23.00	3.00	60.00	20/1 Ne	20/1 Ne
6399 A-2	2/1 LHT	56.90	51.30	5.70	5.60	11.83	2.40	56.90	81.70	64.70	63.30	23.00	3.00	60.00	20/1 Ne	20/1 Ne
M243N151	3/1 RHT	60.23	59.00	5.00	6.10	15.33	4.00	81.00	101.00	76.00	79.00				30/1 Ne	20/1 Ne
6234	2/2 RHT	67.80	57.40	5.70	6.30	14.17	2.60	100.30	120.30	62.00	63.00	24.00	4.00	71.00	40/2 Ne	50/2 Ne
6106 C	3/1 LHT	68.90	57.60	6.70	6.80	12.07	3.23	87.00	104.70	39.70	38.00	28.00	3.00	71.00	40/2 Ne	10/1 Ne
6106 D	3/1 LHT	68.90	57.10	6.70	6.90	12.27	2.70	87.00	104.30	39.70	38.30	28.00	3.00	71.00	40/2 Ne	10/1 Ne
6106 B	3/1 RHT	68.90	57.00	6.70	6.90	12.23	3.13	87.00	104.30	39.70	38.00	28.00	3.00	71.00	40/2 Ne	20/2 Ne
6106 A	3/1 LHT	68.90	57.10	6.70	7.00	12.87	2.97	87.00	104.70	39.70	38.00	28.00	3.00	71.00	40/2 Ne	20/2 Ne
6343 B-W	5/2 RHT	68.00	58.40	7.90	7.00	12.83	3.67	107.70	127.30	70.30	70.30	35.00	3.00	71.00	40/2 Ne	40/2 Ne
6343 B	Steep	68.00	59.00	7.90	7.00	11.93	2.60	109.70	126.70	70.30	69.70	35.00	3.00	71.00	40/2 Ne	40/2 Ne
6052	3/1 RHT	61.10	52.30	6.80	7.10	16.83	5.70	57.10	66.30	30.00	30.70	13.50	4.00	64.22	10/1 Ne	10/1 Ne
6343 A	Steep	68.50	58.50	7.90	7.10	12.40	2.60	108.70	127.30	69.00	71.00	35.00	3.00	71.00	40/2 Ne	20/1 Ne
6343 A-W	5/2 RHT	69.50	59.20	7.90	7.10	11.50	3.00	108.70	127.30	69.00	69.30	35.00	3.00	71.00	40/2 Ne	20/1 Ne
6141	2/1 RHT	57.90	49.60	7.10	7.30	13.43	2.30	74.70	87.00	64.70	60.00	24.00	3.00	60.00	30/2 Ne	30/2 Ne
M243N152	3/1 RHT	63.70	55.00	6.50	7.40	12.50	3.00	71.00	84.00	62.00	63.00				16/1 Ne	16/1 Ne
6112 B	3/1 LHT	65.10	60.40	7.30	7.50	13.40	3.30	56.00	59.00	41.70	42.00	17.00	3.00	70.00	10/1 Ne	10/1 Ne
6113 A	3/1 RHT	65.10	59.10	7.30	7.60	14.60	4.10	56.00	64.00	42.00	41.00	17.00	3.00	70.00	10/1 Ne	10/1 Ne
6112 A	3/1 LHT	65.10	58.40	7.30	7.80	15.50	4.37	56.00	61.00	41.70	41.70	17.00	3.00	70.00	10/1 Ne	10/1 Ne
5834 B	3/1 RHT	59.90	55.00	7.60	8.10	13.10	1.00	58.00	63.00	42.00	43.00	13.50	4.00	64.20	10/1 Ne	10/1 Ne
5834 A	3/1 RHT	58.80	54.50	7.50	8.40	13.00	0.80	59.00	64.00	42.00	42.00	13.50	4.00	64.20	10/1 Ne	10/1 Ne
6625-1	3/1 RHT	70.80	55.50	7.70	10.10	15.40	3.03	56.00	71.30	48.00	52.00	13.25	4.00	74.70	10.7/1 Ne	10.7/1 Ne
6650-1	3/1 RHT	67.60	53.00	7.80	10.20	14.67	2.33	58.70	74.00	44.00	48.30	14.00	4.00	74.70	12.5/9.4/1 Ne	9.4/1 Ne

6650-2	3/1 RHT	67.30	53.00	8.20	10.90	12.53	2.73	59.70	73.70	48.70	51.70	14.00	4.00	74.70	12.5/9.4/1 Ne	9.4/1 Ne
6625-3	3/1 RHT	71.00	56.30	8.70	11.10	13.07	1.97	55.70	70.00	47.00	50.70	13.25	4.00	74.70	10.7/1 Ne	8.3/1 Ne
6560-4A	3/1 LHT	69.48	63.00	10.38	11.60	12.70	2.90	51.67	57.00	44.00	48.00	12.00	4.00		7/1 Ne	6/1 Ne
6626-3	3/1 RHT	69.80	56.80	9.60	11.80	12.67	2.87	51.70	62.30	47.00	49.30	12.00	4.00	74.70	8.3/1 Ne	8.3/1 Ne
6560-3A	3/1 RHT	70.56	63.90	10.33	11.80	10.60	3.10	51.00	56.00	44.00	48.00	12.00	4.00		7/1 Ne	6/1 Ne
6626-1	3/1 RHT	70.00	56.80	9.60	11.80	12.87	2.07	51.30	62.30	47.30	49.30	12.00	4.00	74.70	8.3/1 Ne	8.3/1 Ne
6560-3B	3/1 RHT	70.56	63.40	10.33	11.90	11.50	3.00	51.00	56.00	44.00	48.00	12.00	4.00		7/1 Ne	6/1 Ne
6560-4B	3/1 LHT	69.48	62.80	10.38	12.10	13.10	4.00	51.67	57.00	44.00	48.00	12.00	4.00		7/1 Ne	6/1 Ne
6500-8	3/1 RHT	66.50	63.50	13.00	12.40	11.53	2.67	51.00	54.00	38.00	40.70	12.00	4.00	70.71	6/1 Ne	6/1 Ne
6560-1B	3/1 RHT	71.23	64.10	11.24	12.70	9.25	2.50	50.00	56.00	44.00	46.00	12.00	4.00		7/1 Ne	6/1 Ne
6560-1A	3/1 RHT	71.23	64.00	11.24	13.00	9.75	2.13	50.00	56.00	44.00	48.00	12.00	4.00		7/1 Ne	6/1 Ne
6560-2B	3/1 LHT	69.96	63.80	11.10	13.10	11.50	2.70	50.67	56.00	44.00	48.00	14.00	4.00		7/1 Ne	6/1 Ne
6560-2A	3/1 LHT	69.96	63.30	11.10	13.30	10.50	2.00	50.67	56.00	44.00	49.00	12.00	4.00		7/1 Ne	6/1 Ne
6560-3	3/1 RHT	70.56	58.60	10.33	13.60	16.00	4.50	51.00	62.30	44.00	49.30	12.00	4.00	74.75	7/1 Ne	6/1 Ne
6585-1	3/1 RHT	70.30	59.30	11.30	14.10	14.30	3.30	50.70	61.00	47.70	52.30	12.00	4.00	74.75	7/1 Ne	6/1 Ne
6585-1U	3/1 RHT	70.30	58.90	11.30	14.60	14.30	3.00	50.70	61.00	47.70	49.00	12.00	4.00	74.75	7/1 Ne	6/1 Ne
6585-3	3/1 RHT	70.30	58.90	11.30	14.60	13.50	3.30	50.70	61.00	47.70	49.00	12.00	4.00	74.75	7/1 Ne	6/1 Ne

APPENDIX C
NATURAL STRETCH - LAB PROCEDURE

Fabric
Put benchmarks in the length & width (mark and record initial length and width).
For full width samples, record the initial width.

Optional (if size is present)
Desize/Scour in the small Unimac using the starch/PVA desize procedure:
0.5 - 1.0 g/l Nonionic surfactant.
10 – 20 g/l Alpha amylase enzyme (to remove starch).
Run 20 minutes at 140°F/60°C in a garment machine.
Hot rinse, 190°F/88°C wash, hot rinse, cold rinse, extract.

Slack Mercerizing
Use the steam-heated kettle (or a large pail)
Make a solution with 50% of Sodium Hydroxide (50%) (weight to weight)
Example: Use 20 L water + 13.5 Sodium Hydroxide (50%)
This can be mixed in the kettle while the desize is running in the garment machine.
Slowly add Sodium Hydroxide 50% to the water while stirring the solution to slow the exothermic reaction (safety precaution)
Measured the specific gravity after the caustic has been mixed:
Typical value is 1.262 (30.2 degrees Baume) at 130°F/54°C
Temperature at time of treatment is typically 125°F/52°C
Place fabric in the solution.
Use a polyethylene or stainless-steel paddle to stir the fabric for one minute.
Fabric appearance will change to translucent as mercerization occurs.
Drain the kettle.
By the time it drains, the fabric is in the solution for at least 2 minutes.
Refill and hot wash (140-160°F/60-71°C) to remove most of the alkalinity, repeat.
Fabric returns to its original opaque appearance.
Put fabric sample(s) in the small garment machine and rinse hot 3-4 times.
Fill machine with cold water and add enough acetic acid to lower the pH to 4.5 .
Use a cold running wash to remove excess acetic acid.
Typically, the final pH of the water is nearly 7.0 .
Extract and tumble dry.

Testing
Measure benchmarks - calculate % shrinkage.
For full-width samples, measure the width.
Run ASTM D3107 for stretch & growth.

RESEARCH AND TECHNICAL SERVICES

Cotton Incorporated is a research and promotion company representing cotton worldwide. Through research and technical services, our company has the capability to develop, evaluate, and then commercialize the latest technology to benefit cotton.

- Agricultural research leads to improved agronomic practices, pest control, and fiber variants with properties required by the most modern textile processes and consumer preferences. Ginning development provides efficient and effective machines for preservation of fiber characteristics. Cottonseed value is enhanced with biotechnology research to improve nutritional qualities and expand the animal food market.

- Research in fiber quality leads to improved fiber testing methodology and seasonal fiber analyses to bring better value both to growers and then mill customers.

- Computerized fiber management techniques result from in-depth fiber processing research.

- Product Development and Implementation operates programs leading to the commercialization of new finishes and improved energy and water conserving dyeing and finishing systems. New cotton fabrics are engineered -- wovens, circular knits, warp knits, and nonwovens -- that meet today's standards for performance.

- Technology Implementation provides comprehensive and customized professional assistance to the cotton industry and its customers -- textile mills and manufacturers.

- A fiber-to-yarn pilot spinning center allows full exploration of alternative methods of producing yarn for various products from cotton with specific fiber profiles.

- The Company operates its own dyeing and finishing laboratory, knitting laboratory, and a laboratory for physical testing of yarn, fabric, and fiber properties including High Volume Instrument testing capable of measuring micronaire, staple length, strength, uniformity, color, and trash content.

For further information contact:

COTTON INCORPORATED
WORLD HEADQUARTERS
6399 WESTON PARKWAY
CARY, NC 27513
PHONE: 919-678-2220
FAX: 919-678-2230

COTTON INCORPORATED
CONSUMER MARKETING HEADQUARTERS
909 3RD AVENUE SUITE 1405
NEW YORK, NY 10022
PHONE: 212-413-8300
FAX: 212-413-8377

Other Locations
• Mexico City • Hong Kong • Shanghai •

Visit our website at: www.cottoninc.com

COTTON INCORPORATED