# *Estron* Acetate Yarn
# *Chromspun* Acetate Yarn

EASTMAN

# Contents

# Introduction

## Designers Rediscover *Chromspun* and *Estron* Acetate Yarns

Both fabric and garment designers are rediscovering the fresh look and rich aesthetics possible when using Eastman's *Chromspun* and *Estron* acetate yarns. Eastman produces more than 50 different types of *Estron* acetate yarn and *Chromspun* colored acetate yarn. *Chromspun* acetate yarn is the product of choice for many high fashion fabrics and is available in a rainbow of colors.

*Estron* and *Chromspun* acetate yarns have the same composition, except that colorants are added to the acetate solution prior to spinning to produce *Chromspun* yarn. Solution-dyeing results in yarns and fabrics with colorfast, rich, bright colors.

Yarns of cellulose acetate, a cellulosic polymer made from wood pulp—a renewable resource—have excellent hand, drape, and luster.

Major markets for *Estron* and *Chromspun* acetate yarns include:

- Suit Linings
- Party Dresses
- Blouses
- Choir and Graduation Robes
- Bride and Bridesmaid Gowns
- Drapery Linings
- Casket Linings
- Velvets for Apparel and Home Furnishings
- Decorative and Floral Ribbons
- Medical Tape
- Women's Knit Apparel

## Combination Fabrics

In addition to 100% *Estron* and *Chromspun* acetate yarn fabrics, many mills combine *Estron* and *Chromspun* acetate yarn with yarns of other fibers such as cotton, silk, wool, linen, nylon, spandex, polyester, and rayon—to enhance the best characteristics of each fiber.

For example, *Estron* acetate yarn that is woven with rayon simulates silk or linen. *Estron* acetate yarn woven or knit with nylon or polyester and spandex is used in high-fashion women's wear to produce a wrinkle-resistant fabric with excellent stretch and recovery for excellent form-fitting properties.

Weaving *Estron* acetate yarn with yarns of hightwist sometimes in combination with yarns like polyester or rayon creates a crepe-effect fabric. The *Estron* acetate yarn contributes softness and drapability and creates the crepe texture through differential shrinkage of the acetate and companion yarn when the fabric is formed.

Fabrics of *Estron* acetate yarn with various natural or man-made fibers may also be cross-dyed (contrasting colors for each fiber to produce two-tone effects in a single dyeing operation).

# Product Features

Since their commercial introduction in 1931, *Eastman* acetate yarns have continued to bring a host of benefits to customers throughout the textile industry. The list of product features is impressive.

## Comfort

Studies have shown that wearers strongly prefer suit jackets lined with acetate over identical jackets lined with polyester. For more information visit www.acetateworld.com.

## Rich Colors

Because of its inherent whiteness, *Estron* acetate yarn can be dyed to produce apparel fabrics that are especially bright and vibrant in color. *Chromspun* yarn offers the added advantage of excellent color fastness.

## Luxurious Hand and Drape

The fabric designer can count on *Eastman* acetate yarn for producing fabrics that are soft and supple.

## Crispness

Fabrics such as taffetas call for a fresh, crisp look. Because of their inherent physical properties, *Estron* and *Chromspun* yarns retain their crispness even in damp weather. Low swelling and rapid drying account for good stability to shrinkage and stretch when wet.

## Pleats and Creases

Because *Eastman* acetate yarns are thermoplastic, their shape can be altered by the application of heat and pressure. As a result, fabrics of *Estron* and *Chromspun* yarns can be readily pleated or creased. This feature also makes possible surface patterns, such as a moirè.

## Tailorability

Fabrics containing *Eastman* acetate yarn are easy to cut, sew, and handle.

## Moth Resistance

Moth larvae do not attack *Eastman* acetate yarns. *Estron* and *Chromspun* yarns are resistant to mildew and perspiration.

# Eastman and Acetate: A Brief History

Eastman's expertise with acetate dates back to 1909 with the production of cellulose acetate for use as a photographic film base. During World War I, we provided cellulose acetate to the United States armed forces for coating airplane wings. Since that time, Eastman continues to supply the textile industry with quality products and services:

- 1931—Tennessee Eastman Corporation begins large-scale production of cellulose acetate yarn.
- 1936—Eastman introduces TECA, the first acetate staple fiber.
- 1937—Tennessee Eastman Corporation begins production of acetate dyestuffs.
- 1952—Eastman begins production of *Chromspun* yarn, the first solution-dyed acetate yarn. Eastman begins production of acetate tow for cigarette filters.
- 1967—Eastman begins acetate tow production in England.
- 1983—Tennessee Eastman Company begins operation of the only commercial plant in the United States for making industrial chemicals from coal. This project has been acclaimed as one of the best technological achievements of modern times.
- 1993—Eastman Chemical Company wins the coveted Malcolm Baldrige Award for all-around excellence.
- 1994—Eastman Chemical Company becomes independent of Eastman Kodak Company.
- 1997—Eastman converts 100% to tube spinning and installs robotic packing of acetate yarns. Eastman joins www.acetateworld.com (GAMA).
- 2000—Eastman joins the Global Acetate Manufacturers Association (GAMA). See www.acetateworld.com for more details on this organization and other information about acetate yarn.
- 2001–2004—Eastman continues with significant investments in acetate yarn manufacturing.
- 2005—Eastman becomes the sole acetate yarn producer in North America and the only global acetate yarn producer vertical in acetate flake manufacturing.

# Acetate Yarn—How It Is Produced

Acetate yarn is made from cellulose, a renewable resource obtained from cotton linters and wood pulp.

## Composition

The cellulose, purchased in bleached form, is treated with a mixture of acids and a catalyst to produce cellulose triacetate. Further dilution and precipitation steps result in a solid white flake called cellulose acetate.

## Spinning

The flake is subsequently dissolved in acetone, forming a clear viscous solution. It is at this stage that coloring agents can be added in the production of *Chromspun* acetate yarn. This solution is then extruded through spinnerettes. As the fine liquid streams pass through a curing chamber, warm air evaporates the acetone resulting in solid cellulose acetate filaments. The filaments are then drawn together into a continuous filament yarn at the bottom of the chamber and wound onto tubes.

# Yarn Properties

The physical properties of acetate are unique, especially when compared to those of other manmade fibers such as polyester and nylon. The molecular structure of acetate, for example, is amorphous, as opposed to a crystalline structure for polyester and nylon. Acetate is thermoplastic and has good moisture regain properties. Table 1 shows typical physical properties for *Eastman* acetate yarn.

Table 1

**Typical[a] Physical Properties of *Eastman* Acetate Yarns**

| Property | Reference | Value |
|---|---|---|
| Breaking tenacity (standard), g/d | ASTM D2256 | 1.2–1.5 |
| Breaking tenacity (wet), g/d | ASTM D2256 | 0.8–1.2 |
| Specific gravity | ASTM D792 | 1.32 |
| Commercial moisture regain, % | ASTM D1909 | 6.5% |
| Sticking point, °C (°F) | Observation | 177–191 (350–375) |
| Softening point, °C (°F) | Observation | 204–229 (400–445) |
| Melting point, °C (°F) | Observation | 260 (500) |
| Burning characteristics | Observation | Burns relatively slowly |
| Elongation | ASTM D2256–80 | 22–25% |

[a]*Values given are typical and should not be considered as specification values. Eastman makes no claim that any particular shipment will conform exactly to these values.*

# Processing the Yarn

Appropriate processing conditions and techniques must be used to take advantage of the desirable qualities of *Eastman* acetate yarns. This section discusses those techniques that have been shown by experience to work well with *Estron* and *Chromspun* yarns.

- *Eastman* acetate yarns should not be processed at temperatures above 88°C (190°F).
- If a fabric containing *Eastman* acetate yarn is to be heat-set, it should first be dried.

## Beaming

While beaming may be accomplished on sectional (silk) equipment, the use of cotton-system beaming is preferred.

## Beaming Conditions

Condition the yarn at 26° ± 1°C (78° ± 2°F) and 66° ± 2% relative humidity for at least 24 hours prior to beaming and maintain similar conditions in the beaming area.

## Beaming Speeds and Tensions

Beaming speeds will vary with a number of equipment factors and should be consistent with the equipment manufacturer's recommendations. Keep yarn tensions to a minimum; usually not to exceed 0.10 to 0.15 grams/denier. It is especially important that yarn tensions be uniform across the warp sheet, i.e. uniform end to end. Keep yarn contact points to a minimum, and contact surfaces clean and smooth. The *Whorl* disc and other tension control systems can be used. Surface contact points should be either satin-finish chrome or matte-finish ceramic. High polish chrome surfaces should be avoided.

## Fabric Appearance

To avoid potential variation in surface appearance, horizontal creeling is suggested. Horizontal creeling will result in better distribution of ends on the loom beam.

# Preparing Loom Beams

It is necessary to apply a size formulation to *Eastman* acetate yarns to prevent broken filaments during the weaving process. It is important to select the right combination of slasher equipment, size, and slashing procedure to ensure satisfactory results. In addition, it is important to carefully coordinate warp moisture and weave room conditions. Failure to do so can result in poor quality warps and defective fabrics.

## Slasher Types

There are a number of slasher types that can be used successfully to size acetate yarn. Both conventional and single end slashers are widely used.

## Stretch Level

The stretch level used is very critical and should be as low as possible. Excessive stretching reduces the elongation of the yarn, which can result in warp streaks after dyeing. Ideal stretch conditions should be between 4% and 6% for single-end and 6% and 8% for conventional slashers. Care should be taken during leasing to ensure that filaments are not broken during hard size breaks at the separator rods.

Single-end slashers tend to provide better protection for the yarn and create less broken filaments.

## Size Selection

Size selection is critical to achieving optimum weaving efficiency, fabric quality, and cost. Factors that affect the size selection include:

- Ease of application
- Ease of removal
- Compatibility with yarn lubricants
- Cleanliness on looms

The choice of slashing formulation will also depend on slashing and weaving equipment used, fabric construction, and mill differences. Generally speaking, a typical size add-on would be about 4.0% by weight. Before selecting a size, the size supplier should be consulted regarding proper application.

# Weaving

Today, most weaving is done on air jet, water jet, or rapier looms. The entanglement level on yarns of *Estron* and *Chromspun* is designed to be high enough to get good weaving efficiencies, but low enough to avoid a flashy fabric appearance. Eastman produces several yarn products that perform well on these type looms in both warp and filling.

## Yarn Types

As air-jet weaving machine sophistication and speeds increase, an "air friendly" filling yarn is preferred. Air friendly refers to a yarn that enables the loom to use less air and thus avoid damaging the yarn during pick insertion. Pick timing controls are essential to maintain appropriate air pressure. The use of highly polished, fully profiled reeds is recommended, along with regular reed maintenance and cleaning.

## Yarn Conditioning

Condition acetate yarns to weave room temperature and humidity prior to using. Conditioning is especially important for filling yarns. Ideal weave room conditions are 21°–27°C (70°–80°F) and 70% relative humidity.

*Estron* and *Chromspun* acetate warp yarns perform satisfactorily on high-speed, air-jet weaving machines. Proper slashing procedures and warp tension are important.

## Air-Jet Weaving

TFAJ yarns are designed for use as filling on air-jet machines. Excessive air pressure should be avoided to prevent damage to the yarn. For best all around performance, pick timing with automatic air control is recommended. Reeds should be fully profiled, highly polished, and regularly maintained.

## Water Jet and Rapier Weaving Machines

*Eastman* acetate warp and filling yarns are also suitable for use on water-jet weaving machines. The procedure for slashing water-jet warps is the same as those for dry-loom warps, except for the size formulation used. The size used for slashing water-jet warps must be insoluble in water. Care must be taken to balance loom beam moisture with weave room temperature and humidity. Otherwise, warp-related problems such as blistering and sticking may be encountered.

# Knitting

*Eastman* acetate yarns are useful for both warp and circular knitting applications. Excessively high tensions should be avoided to prevent damaging the yarn and breaking filaments. The use of a positive feed machine is necessary, and all yarn contact points on the machine must be regularly checked for wear. It is especially important that yarn tensions be uniform, end-to-end, and package-to-package.

## Circular Knitting

Standard circular knitting procedures yield good results with both *Estron* and *Chromspun* acetate yarns. *Chromspun* and *Estron* HTFK yarns are recommended for circular knitting.

## Warp Knitting

Standard warp knitting techniques may be used to produce fabric of excellent quality. Some common constructions can be produced using acetate yarns on both bars or combinations of acetate on the top bar and other yarns on the bottom bar. All metal contact points must be smooth to keep broken filaments to a minimum.

# Dyeing and Finishing

For best results, fabrics woven of 100% *Estron* acetate should be dyed in an open-width jig or atmospheric beam dyeing machine to help minimize the formation of creases and crack marks. Fabric blends made with *Estron* acetate warp yarn and spun rayon filling can be dyed in open becks and atmospheric-jet dyeing machines. When dyeing blends, care should be taken not to overload the becks or jets and to maintain a bath ratio of 20:1 to 30:1. Overloading can result in severe crack marks that cannot be removed on the tenter frame during drying. Level dyeings are best achieved with disperse dyes that have similar energy levels. These are dyes that exhaust at similar rates.

## Scouring and Desizing

- Rinse in cold water to remove any tints that might be present.
- Before dyeing, thoroughly remove any warp size to avoid warp streaks in the finished fabric.
- Set bath temperature at 38°C (100°F). Add anionic detergent and soda ash to pH 8.5–9.0.
- Raise temperature to 71°–82°C (160°–180°F). Hold 30 to 60 minutes.
- Cool to 60°C (140°F). Overflow rinse 10 minutes, then drain.
- Repeat rinse at 49°C (120°F).
- Drain and refill for dyeing.

Anionic detergents are preferred to nonionic detergents in scouring because it is more difficult to remove nonionic detergents from fabric. Residual nonionic detergent left on the fabric will interfere with the dye dispersion. This is especially important in jig dyeing where the efficiency of rinsing is not good. Avoid using caustic, strong alkalis or cationic detergents since these may impair removal of the size. Also, if acetate is exposed to pH levels greater than 9.0, saponification will occur, converting the acetate to regenerated cellulose. This will adversely affect the dyeing process. A simple test to see whether saponification has occurred is to expose the desized but undyed fabric to direct dyes.

## Dyeing

Cellulose acetate should always be dyed with disperse dyes. In jig dyeing, lower energy dyes are preferred over higher energy dyes. Basic dyes (also known as cationic dyes) may yield brighter shades, but may also dye unevenly. Basic dyes have no affinity for acetate, and any dye that only stains a fiber will tend to go on non-uniformly. In addition, basic dyes have a good affinity for acrylic, which is present in many of the sizes used on acetate. If the size is not completely removed, the basic dye will tend to dye the acrylic size and cause warp streaks.

Because the dyeability of acetate with basic dyes cannot be controlled, Eastman will not assume any responsibility for dyeing results with this class of dyes. Use of cationic or basic dyes can be detected.

Fabrics containing 100% *Estron* acetate and blends of acetate with spun rayon can be dyed as follows:

- Add the following auxiliaries to a fresh bath at 27°C (80°F):
  0.33 g/l sequestrant, or *Calgon* water softener*
  0.08 g/l monosodium phosphate*
  0.07 g/l anionic detergent
  ***Note:*** *Additional auxiliaries will be needed depending on the type of dye used for the rayon.*
- Adjust pH to 6.5–7.0.
- Add disperse dyes that have been pasted in warm water with a small amount of anionic detergent and dispersed in water at 71°C (160°F).
  ***Note:*** *Rayon dyes should be added and mixed according to the manufacturer's instructions.*
- Raise temperature slowly to 82°–88°C (180°–190°F).
- Dye for 1 hour at 82°–88°C (180°–190°F).
  ***Caution:*** *Dyeing at temperatures above 88°C (190°F) may result in delustering and/or fabric damage.*
- Drop bath.
- Rinse well.

**Regional regulations may limit the use of phosphates due to foaming potential in plant water affluent released to streams.*

## Disperse Dye Selection for Use With Acetate

Acetate disperse dye selection should be based on two main criteria:

1. Dyes that exhaust well together
2. Colorfastness

### Exhaustion Characteristics

Disperse dyes exhaust well on acetate fiber but can exhaust at a different rate. This can affect uniform shade in open width dyeing with jig and beam dyeing. Side to center or end to end shading can be problems. Proper batching helps in jig and beam dyeing. The use of closed jigs can also help minimize these problems. Proper dye selection and dyeing temperature are equally important considerations. For smooth, level dyeings, dyes that have relatively similar exhaustion curves produce good results. Dyes that have good exhaustion at lower temperatures can be described as low energy dyes. Dyes that require higher temperatures to achieve significant exhaustion are classed as higher energy dyes. Ideally dyes should be selected from the same or at least consecutive energy group for similar dye strike. When dyes are selected from different groups it is best to choose a dyeing temperature that is suitable for the higher energy dye so that both dyes will be striking at the same time. A dyeing temperature that is too low results in a slow dye strike where inadequate exhaustion will occur, but a dyeing temperature too high is equally a problem where unlevelness results from a very quick dye strike.

Four energy levels* were established for these selected acetate disperse dyes based on their exhaustion curves:

***Low Energy***
C.I. Disperse Yellow 34
C.I. Disperse Yellow 3
C.I. Disperse Orange 58
C.I. Disperse Red 30
C.I. Disperse Blue 3

***Low/Medium Energy***
C.I. Disperse Yellow 86
C.I. Disperse Red 137
C.I. Disperse Brown 22
C.I. Disperse Blue 102

***Medium Energy***
C.I. Disperse Yellow 42
C.I. Disperse Red 136
C.I. Disperse Red 35
C.I. Disperse Red 338
C.I. Disperse Blue 27
C.I. Disperse Blue 7

***High Energy***
C.I. Disperse Orange 37
C.I. Disperse Red 88
C.I. Disperse Red 117
C.I. Disperse Blue 60

***Other Dyes With General Application:***
C.I. Disperse Orange 25
C.I. Disperse Orange 59
C.I. Disperse Red 78
Disperse Black TG (Mixture)

**These dyes are grouped relative to dyeing acetate and should not be confused with their affinity for other fibers such as polyester.*

Blacks:

Black shades on acetate can be achieved in several ways depending on depth, richness, and colorfastness. Three methods are suggested with comments:

1. Chromspun Black—Best depth and colorfastness from producer colored acetate
2. Developed Blacks—Good depth, wet fastness satisfactory if applied correctly
3. Disperse Black Mixtures—Adequate black for some end uses, check wet fastness

### Colorfastness

Crock fastness, wash fastness, gas fastness, and thermal stability are some of the properties that must meet the end use requirements of a garment manufacturer. Disperse dyes on acetate can be subject to gas fading due to oxides of nitrogen usually from gas heating. Selected disperse dyes with good gas fastness have resistance to shade change under exposure conditions. Dyes such as Disperse Blue 3 will fade to a reddish blue. This type of dye if used should include a gas fading inhibitor which can be exhausted onto the fiber similarly to a disperse dye. Users are encouraged to check the fastness after finishing insuring that product specifications are met.

*Chromspun* yarns have outstanding crocking fastness. In certain applications, crock testing will indicate color transfer. This is usually due to abrasion of filament lobes that can be easily remedied by application of a hand softener in finishing.

## Package Dyeing

Acetate filament yarns are very difficult to package dye since the yarns tend to slough off the package. The package integrity can be improved by winding only small packages less than one pound with a firm pineapple shaped wind. Covering the package with a cotton sock can slightly reduce the tendency to slough. Set the flow cycle to inside-out only and keep the pump running throughout the dye cycle without dropping the bath until ready to unload. Overflow wash for rinsing. Extended dye cycles for adds or repair increase the potential for problems. As an excellent alternative to package dyeing, Eastman *Chromspun* yarns are producer colored, offer excellent fastness for most shades and are available in a variety of colors. *Chromspun* yarns are ready to use and avoid all of the time consuming, special handling problems from sloughing, dye channeling, unlevelness, and loss of damaged yarn that can occur in package dyeing.

## Improving Whiteness

*Estron* acetate whiteness meets expectations for most applications. For extreme whiteness, selected optical brighteners can be applied similarly to exhaust dyeing disperse dye to acetate from an aqueous medium. Lightfastness should be tested to determine if adequate for the end use. Dull yarns are sometimes perceived as being whiter than bright yarns.

For end uses requiring a higher level of whiteness, *Estron* dull yarns may be employed.

## Drying of Dyed Fabric

In many instances, excess moisture is removed from dyed fabrics by running open width fabrics over a water extraction suction slot. This makes drying of fabrics more economical. Acetate fabrics are relatively easy to dry. Lining fabrics are generally dried by passing over metal cylinders that are steam heated to 121°–149°C (250°–300°F). Some fabric constructions can be dried in loop dryers or tenter frames at 93°–135°C (200°–275°F). With either method, tension in the length and width directions must be kept to a minimum to not distort the fabric. Excessive drying temperatures will reduce the naturally soft hand of acetate fabrics.

# Care Instructions

Many fabrics and garments containing acetate are not considered washable due to the type garment involved, such as party dresses and linings for suits. However, other garment and fabrics, knit fabrics in particular, are considered by many to be hand or delicate cycle washable.

# *Eastman* Acetate Yarns—The Products

Through the years, Eastman has maintained a product mix tailored to the changing needs of its customer base. The result—a variety of product and package options available to the fabric designer.

*Estron* and *Chromspun* acetate yarns are available in various deniers, lusters, and colors. Both yarns are available in deniers from 75 to 300. Typical deniers include 75, 100, 120, 150, and 300. The yarns are produced in the following types:

TFAJ —Air jet filling
TFWJ —Water jet filling
HTFK—Circular knitting
HTF—Warp knitting, weaving warp rapier filling

*Chromspun* acetate yarn is available in a wide range of colors. Please contact your local Eastman Sales Representative for a *Chromspun* Color Selector.

EASTMAN

**Eastman Chemical Company**
**Corporate Headquarters**
P.O. Box 431
Kingsport, TN 37662-5280 U.S.A.

Telephone:
U.S.A. and Canada: 800.EASTMAN
(800.327.8626)
Other Locations: (1) 423.229.2000
Fax: (1) 423.229.1193

www.eastman.com

Material Safety Data Sheets providing safety precautions, that should be observed when handling and storing Eastman products, are available online or by request. You should obtain and review the available material safety information before handling any of these products. If any materials mentioned are not Eastman products, appropriate industrial hygiene and other safety precautions recommended by their manufacturers should be observed.

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